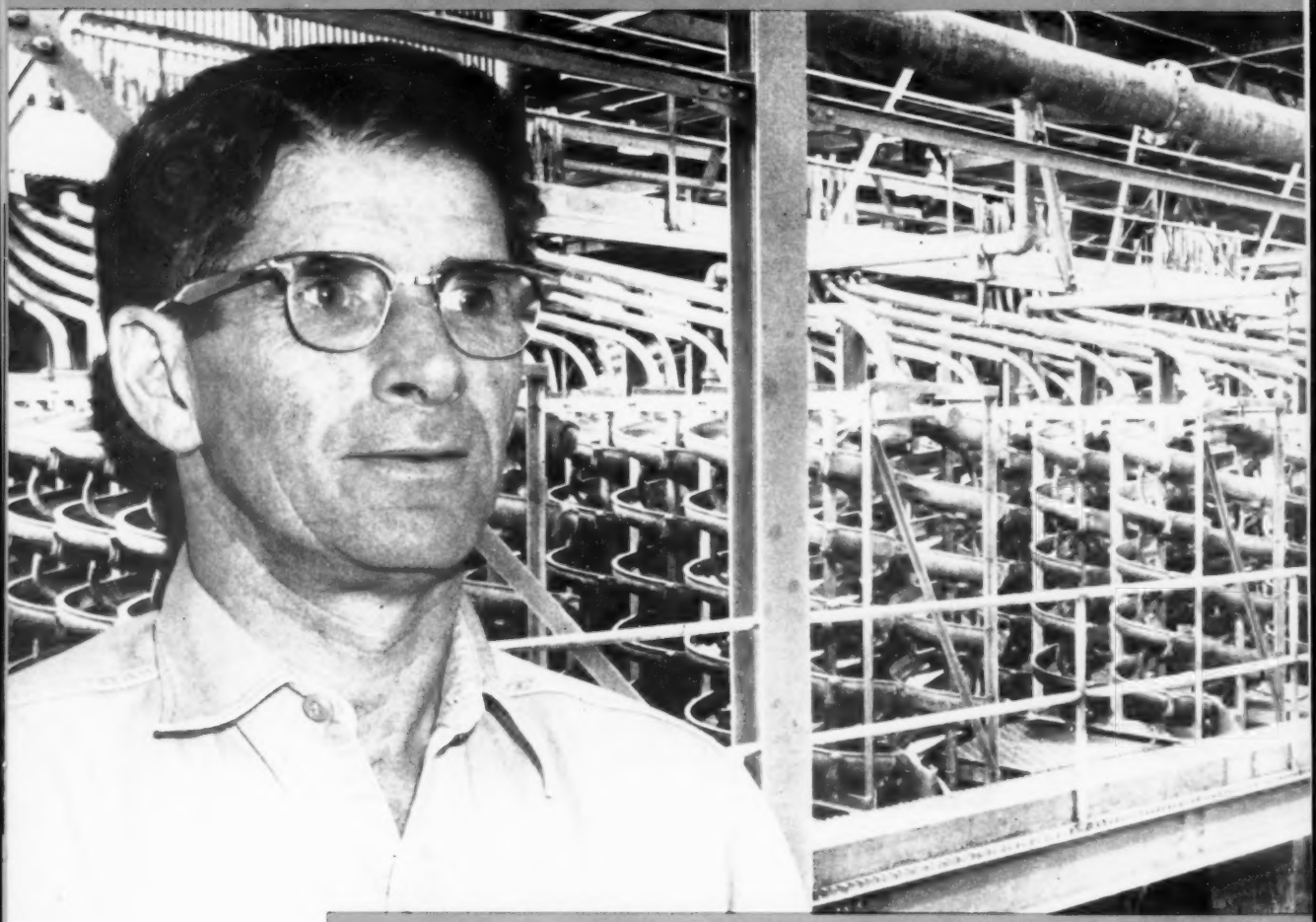
MINING WORLD

November
1959



BY PRODUCT RECOVERY

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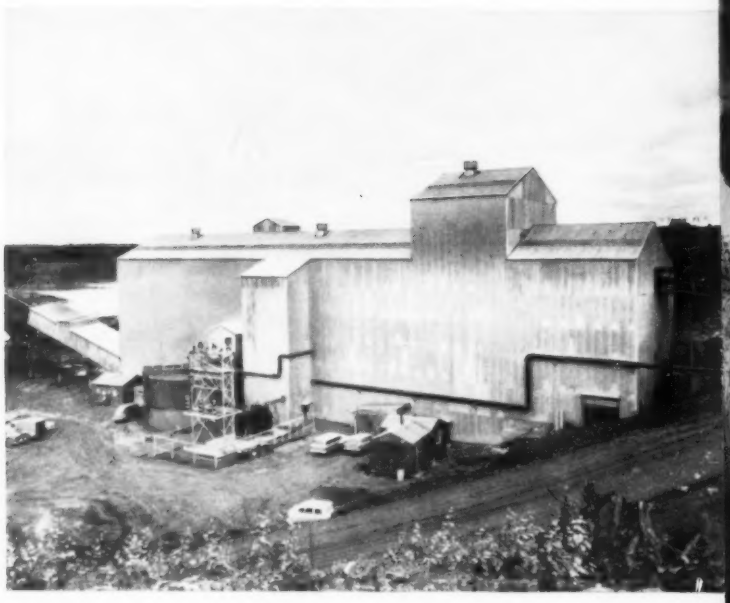
NEW FILL PLANT designed around piston pumps p. 32

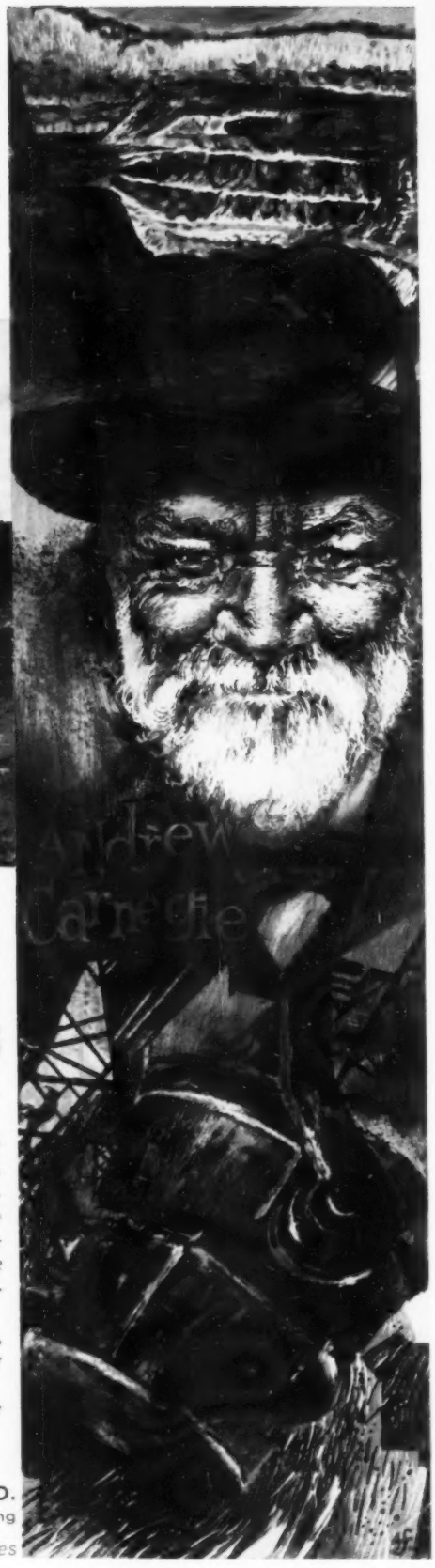
CHLORATES solve blasting problems in Sweden p. 44

SEISMIC STUDIES for open pit equipment selection p. 46

"Imagination . . . is the source of human improvement; experience its implement"



Steep Rock Iron Mines, Ltd.



FUTURE IN IRON: MODERN PLANTS TO SATISFY GIANT, NEW DEMANDS

Iron is still king. More than ever, it is the world's most-used, most-needed metal.

And today the key to meeting increased demands for iron is *mineral engineering*, the imaginative use of technology, processes, methods and equipment to increase output while keeping costs in line.

That is why the men of WKE consistently are called upon to develop iron-producing facilities. The extent of their successful experience in mineral engineering is reflected in a record of some *forty-five iron plant contracts*. Many of these are *repeat* contracts for the industry's leading companies.

WKE services in these projects include feasibility studies, design and construction of pilot facilities as well as large-capacity production plants.

Details on the WKE record in iron and other fields of industry are yours for the asking through any WKE office.

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There's still another "plus"—the Tiger's exclusive integral type pusher leg, with retractable piston rod. Operates on a single air supply!

This isn't the whole story by any means. For more facts about the amazing new Tiger rock drill and how it can speed *your* drilling, call your nearest Atlas Copco representative. Or, write to us at Dept. MW-10.

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HEAPS IN A HURRY — cuts minutes from the miles . . . That's why the Curtiss-Wright CW-215 moves the most dirt — makes the most profit for contractors like R. C. Wetherall, shown here working on a West Virginia road job . . . This hustling pair of 215s consistently pack in heaping loads of clay, shale and rock — and really keep the pusher operator hopping to keep up with their fast cycles.

UNUSUAL MACHINE? Not really! You'll find the same high performance in the entire CW line — from the 7 cu. yd. CW-27 to the big CW-226, largest two axle scraper on the market. Check any model against your job requirements . . . put "Yards Ahead" performance to work for you.

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215

CW-215 SELF-PROPELLED SCRAPER

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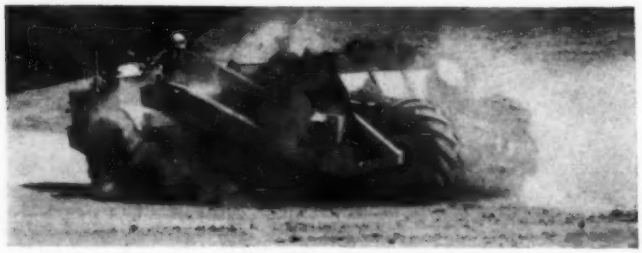

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SOUTH BEND, INDIANA

MINING WORLD

. . . . . including the Export Edition, WORLD MINING

VOL. 21 NO. 12 November 1959

New Alkaline Circuit at Uranium Reduction Company's Moab, Utah mill treats high lime ores and cuts sulphuric acid consumption 50 percent 31

Hecla Pumps Hydraulic Fill over 9,000 feet from mill to Star mine cut and fill stopes. Stopes below Star Tunnel are filled by gravity from end of long line; stopes 1,000 feet vertically higher are filled by second pump. Gardner Denver FD-FXD piston pumps are used 32

Climax's New Byproduct plant recovers tungsten, tin, and pyrite from molybdenite flotation tailing. More than 32,000 daily tons are treated in 704 Humphreys spirals to produce gravity concentrate from which pyrite is floated, tungsten tabled and magnetically separated, and tin tabled 38

Chlorate Explosives give good results in Swedish iron mine. They are competitive in cost and use with regular ammonium nitrate and nitroglycerine explosives. Their use is condemned in the United States 44

New Seismic Method helps to determine whether to rip overburden or blast it in open pit mines. It is much cheaper if you can rip it. Caterpillar Tractor Company has developed simple field method to determine rippability 46

Operating and Maintenance Tips for belt conveyors will save you money. Set up a program which includes: regular inspection, adequate lubrication, good skirtboards, and belt cleaning 55

Carolina's Forgotten Gold is worth another look. The Reed mine northwest of Charlotte hold's worlds record for nugget production. The last mine closed about 1889 63

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MILLER FREEMAN PUBLICATIONS

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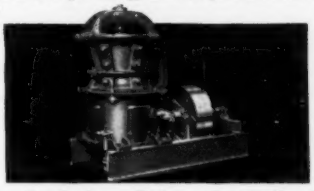
Sturtevant Construction Assures Long Mill Life at Top Loads

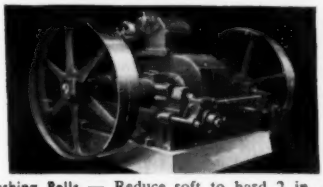
Sturtevant crushing and grinding machinery answers the long life top-load production problem for medium to small size plants. Many Sturtevants have been operating above rated capacities for more than 25 years, and *without a major repair.*

"Open-Door" design gives instant accessibility where needed — makes cleanouts, inspection and maintenance fast and easy. Machines may be set up in units to operate at equal quality and capacity.

Jaw Crushers — Produce coarse (5 in. largest model) to fine (⅛ in. smallest model). Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smallest sizes operate on double cam principle — crush double per energy unit. *Request Bulletin No. 062.*



Rotary Fine Crusher — Reduce soft to medium hard 3 to 8 in. material down to ¼ to 1¼ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Non-clogging operation. Single handwheel regulates size. *Request Bulletin No. 063.*



Crushing Rolls — Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types — Balanced Rolls; Plain Balanced Rolls; Laboratory Rolls — all may be adjusted in operation. *Request Bulletin No. 065.*

Hammer Mills — Reduce to 20 mesh. Swing-Sledge Mills crush or shred medium hard material up to 70 tph. Hinged-Hammer Pulverizers crush or shred softer material at rates up to 30 tph. Four Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30½ in. Four Hinged-Hammer Pulverizers with feed openings from 12 x 12 in. to 12½ x 24 in. *Request Bulletin No. 084.*

**Reports Manager W. Carleton Merrill concerning Sturtevant Swing-Sledge Mill at James F. Morse Co., Boston.*

STURTEVANT
MILL COMPANY
157 Clayton St., Boston 22, Mass.

MINING WORLD, November, 1959. Volume 21, No. 12. Published monthly except April, when publication is semi-monthly at Emmett St., Bristol, Conn. Executive, advertising and editorial offices, 500 Howard Street, San Francisco 5, California. Subscription in United States, North, Central and South America, $4.00 per year; other countries, $5.00 per year. Entered as second class matter Oct. 10 1951 at the Post Office at Bristol, Conn., under act of March 3, 1879. Postmaster: please send notice 3579 to MINING WORLD, 500 Howard Street, San Francisco 5, Calif.

The Importance of Balanced Compounding in Portable Cable Design

A portable cable is constantly under attack from many different directions. It is dragged over rough floor surfaces and rocky terrain, crushed under the wheels of trucks and carts, continually bent, flexed and stretched. In addition, it is very often subjected to attack by water, solvents, oil and ozone.

To give long, dependable service, portable cables must be able to withstand rough treatment, and must have built-in protection against all deteriorating factors. Moreover, they must possess other desirable qualities such as lightness and flexibility.

The science in designing these cables is to add the necessary ingredients in the jacket to provide maximum protection along with the maximum of other desirable features. This is where *Balanced Compounding* comes in. It is very easy to provide protection against one or two of the deteriorating factors, simply by loading the compound with an ingredient which is impervious or highly resistant to these factors. Unfortunately, however, the ingredients which provide resistance to abrasion or crushing may be highly susceptible to attack by oil or water; and vice versa.

The cable designer's problem, then, is to attain a balance in his compounding formula which will provide maximum protection against one deteriorating factor without reducing protection against others below the danger point.

To the buyer of cables, this means that *quantity* of any one ingredient is unimportant, unless it is considered in relation to the over-all ability of the cable jacket to resist *all* of the abuses to which it is subjected.

For balanced resistance to all these abuses, the best assurance you can get lies in the quality of the research and development facilities of the manufacturer, and the product's record of performance.

This is one reason why — in those industries where portable cables are continually used or purchased as components of a manufactured product — Simplex Tirex Cables are regarded as the standard.

Proof of the worth of Tirex *Balanced Compounding*, which gives balanced resistance to all the deteriorating factors of normal use, can be found in the fact that Tirex cables have been successfully performing under the most rugged operating conditions for periods ranging up to twenty years.

BALANCED COMPOUNDING CURED-IN LEAD

Simplex

WIRE & CABLE COMPANY

Cambridge, Massachusetts and Newington, New Hampshire

a million yds. a month . . .

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Time for a Test

The U. S. Bureau of Mines is in the safety business. It does a good job, too; deserves and receives the thanks of the mining industry; in fact, by far, safety is the Bureau's most important business.

MINING WORLD isn't in the safety business and never will be. However, it is in the business of collecting information on mining practices and new developments in all the world's mines.

The article on "Chlorate Explosives" on page 44 of this issue is an example of how information is collected on what's happening in Sweden and the United States.

Read the article yourself and see the surprising results of chlorate blasting at Kiruna, Sweden's largest iron ore mine where one of the world's most progressive and imaginative engineering and research staffs is at work. Then check the highlights of a U. S. Bureau of Mines report on chlorates.

MINING WORLD thinks that the U. S. Bureau of Mines should read the report from Kiruna. Both reports are correct, undoubtedly. The big question is whether the Bureau has shut the door and locked it too tight—"as a matter of policy, it does not test for use in mines any explosive containing chlorate or perchlorate as a major ingredient."

MINING WORLD doesn't recommend the use of Imatrex or Snoratrex. It does, however, strongly feel that if the Swedes can use it safely, then the Bureau should at least test it and publish its findings.

It's time for a Bureau test of Imatrex and Snoratrex.

Good As Gold

The old and well known phrase "Good As Gold" is as true today as it was in the days of the Phoenician placer miners. However, it all depends in which part of the world you are to really make the phrase come true. Today's phrase most aptly applies outside the United States where individuals can and do buy, own, and sell gold as they wish. The great outflowing of gold from the United States in the last year is proof that the gold is better outside than in. Governments want it; so do business firms, and individuals, too.

United States citizens are now turning to Canada for gold. There is a growing business in selling gold bars to United States citizens who immediately have it stored in a Canadian bank. Actually a warehouse receipt is issued to the buyer which can be converted into gold bars upon presentation at the warehouse.

One most successful uranium millionaire is providing for the future financial security of his children by developing gold mines both in and outside the United States. He figures gold reserves are better than money in the bank.

Here are two ways for United States citizens to own gold. Take your choice.

a million yds. a month . . .

moved by Euclid "Twins"

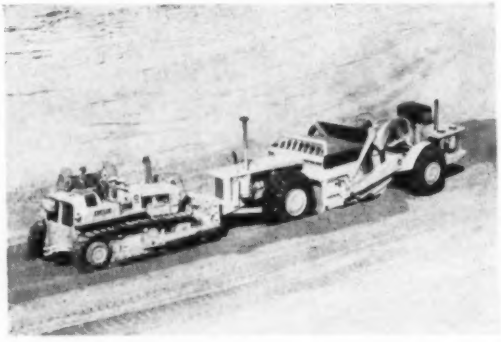
At a mining operation in central Wyoming, a fleet of 18 Euclid scrapers is removing overburden from uranium ore at a rate of a million cu. yds. a month . . . nearly 21 million cu. yds. will be moved to uncover the ore body. It's a big, tough job to move that quantity of heavy sand over a mile of adverse grades up to 12%.

Maco Construction Co. of Rawlins, Wyoming, contractor on this stripping project, bought 12 Twin-Power "Euc" Scrapers of 24 yd. struck capacity to maintain high speed production. With two engines and all-wheel drive, these scrapers have the power and traction needed to move big loads up steep grades from pit to dumping area. Twin-Power is paying off in the big performance of Maco's five TC-12 Euclid crawler tractors, too—they're used for push loading this all-Euclid fleet of scrapers.

Wherever big tonnages must be moved on mine, quarry, industrial and heavy construction work, Euclid equipment provides more work-ability and better return on investment. The dealer in your area will be glad to supply facts and figures on Euclid rear-dump and bottom-dump haulers, scrapers, crawler tractors and front-end loaders.

EUCLID Division of General Motors, Cleveland 17, Ohio

Big power and big capacity pay off in big production . . . Euclid TC-12 Crawler Tractor has 2 engines that deliver 425 net h.p. . . . "Twin" Scraper of 24 yd. struck capacity also has 2 engines (563 total h.p.) and all-wheel drive with separate Torqmatic Drives for each axle.



GM GENERAL MOTORS EUCLID

EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE

MINING WORLD NEWSLETTER

November 1959

ASBESTOS IS IN DEMAND IN CALIFORNIA . . . for a variety of building products. This has led to a reappraisal of local deposits. Jefferson Lake Sulphur is sampling diamond drill cores in its pilot plant mill near Copperopolis to determine fiber size and concentration. Union Carbide has acquired additional asbestos-bearing property west of Coalinga where it originally had some holdings.

ACTIVE PROSPECTING AND DETAILED EXPLORATION . . . recently turned up several mineral deposits in Yugoslovia. Long considered one of Europe's most highly mineralized countries, further discoveries will undoubtedly be made. In the news are the Bela Stena magnesite mines, the Arandjelovac magnetite deposit, and the Kosmaj lead deposit.

A BREAKTHROUGH ON COLUMBIAN MILLING LOOMS . . . St. Lawrence River Mines hopes to become Canada's first columbium producer with a new physical separation process. A pilot plant will be built in Montreal to treat open-pit ore from Oka.

A $2,800,000 NICKEL PLANT IN SOUTHERN RHODESIA . . . will be built with Japanese funds. Shimura Kako Chemical Processing Company will participate with Anglo-Vaal Ltd. in joint venture. Ore will come from Trojan mine at Bindura.

RUSSIAN CLAIMS FOR SHAFT SINKING RECORD . . . are listed here as matter of interest. New world record of 922 feet in one month by Vaal Reefs is already described in this issue. Russian claim is that from March 30 to April 30, 1959, 868 feet of 18-foot-diameter shaft were sunk and concrete lined. This No. 3 shaft in Don coalfield was sunk through sandy ground, clay, and argillaceous slate. Drilling, mucking, use of multistage sinking platform, and collapsible steel forms apparently followed South African practices.

AN AERIAL SURVEY OF MOROCCO'S MINERAL POTENTIAL . . . is being carried out by Fairchild Aerial Surveys. Two regions are being examined for iron ore, apparently to justify a steel industry. Survey of third region is to determine favorable geological structures.

GOLD STRIKE ON MOTHERLODE . . . makes headlines in national papers. Fittingly enough, it was at the old camp of Coarsegold. It's good to have gold in the news again, and it will continue to grow in importance as gold reserves drop with continuing shipments abroad.

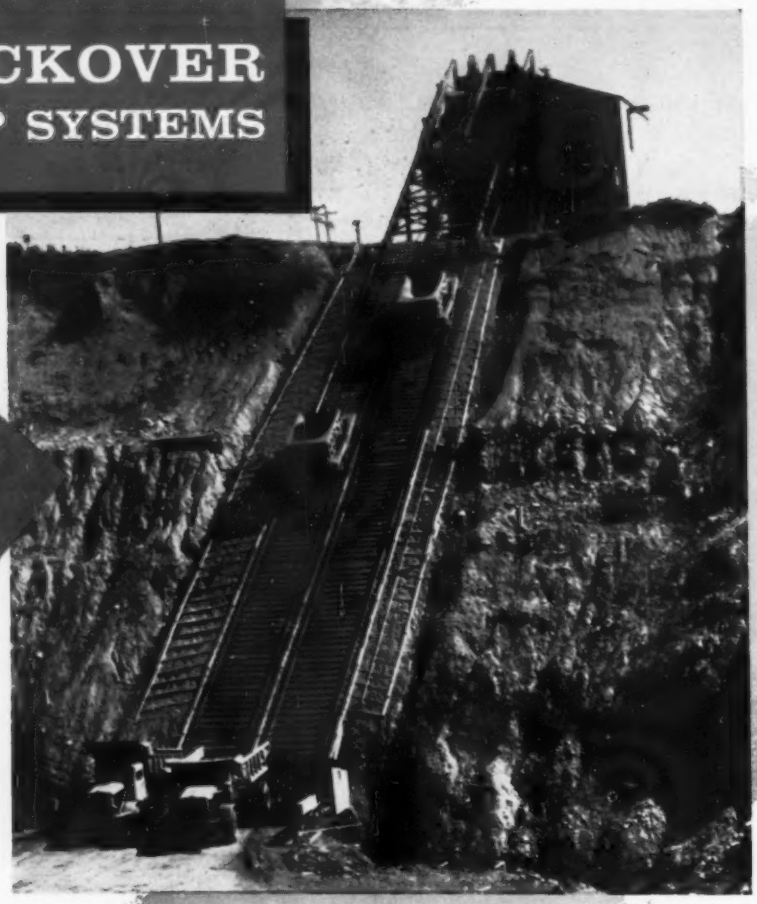
NORTH AUCKLAND BAUXITE IN NEW ZEALAND . . . could be more important than actual bauxite discovery indicates. Local refining to aluminum metal could be real development. New Zealand has great possibilities for developing cheap electric power. Meanwhile, government plans to retain sole mining rights.

CONGO CARBONATITE HOLDS PROMISE FOR COLUMBIUM PRODUCTION . . . SOMIKUBI, a new company formed by Comite National du Kivu and Compagnie Miniere des Grands Lacs African, has developed two types of carbonatite ore. The hard unaltered core contains 0.55% Cb_2O_5. An adjacent, but unconsolidated, ferruginous deposit, contains at least 30,000,000 tons assaying 1.34% Cb_2O_5.

INTEGRATED STEEL MILL IN WESTERN CANADA . . . will probably be built in Alberta where North American Utilities of Canada is considering five sites. The Burmis area looks promising with coal and iron; Carter Creek near Dillon, Montana would be major source for iron concentrate.

Elevate materials at LOWEST COST PER TON

with ROCKOVER SKIP SYSTEMS



IN USE SINCE 1949

The ROCKOVER SKIP SYSTEM has proven to be the most economical method to elevate materials from open pits. It uses the shortest and fastest hauling route, has the lowest operating and maintenance costs and requires no large investment in parts and standby equipment.

Rockover Skip Systems require no expensive wide roads for pit access and require a minimum of personnel . . . are flexible to follow pit bottom as operations go deeper . . . haul either waste or ore at anytime . . . may be loaded at any desired bench and require no sizing equipment in the pit.

NICO SKIPS FROM 15 TO 50 TON CAPACITIES AVAILABLE

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CAPITOL CONCENTRATES

Action On Wilderness Bill Postponed

The Senate Interior Committee, late in August, announced its decision to postpone until next year any action on proposed legislation to set aside huge areas of the public domain for a vast wilderness system.

Two developments immediately prior to the announcement were considered significant. The first was a statement by Senator Dworshak of Idaho that he planned to offer amendments at the next committee meeting to provide, in effect, that nothing in the act could affect the application of the mining laws to any lands included in the wilderness system.

The second was a letter by Senator O'Mahoney of Wyoming to Committee Chairman James E. Murray, stating: "I think this matter (wilderness bill) is tremendously important and should not be finally handled until the next session. . . . When one considers the events of the last few years one knows that we are entering a new age and that nobody can determine what will be discovered in the way of natural resources in the near future in this vast area. . . . I think we should hesitate to lock this up, or any part thereof, upon the plea of preserving a wilderness."

Placer Claim Mill Sites Are Approved

On September 9 the Senate passed, with amendments, S. 2033, introduced by Senators Bible and Cannon of Nevada, to permit patenting of mill sites adjacent to placer mining claims. The bill is now before the House Interior Committee.

This bill would amend the mining laws to provide that where nonmineral land is needed by the proprietor of a placer claim for mining, milling, processing, beneficiation, or other operations in connection with such claim, such land may be included in an application for a patent for such claim, and may be patented therewith subject to the same requirements as to survey and notice as are applicable to placers. No location of this type for nonmineral land could exceed five acres, and the payment is to be at the rate applicable to placer claims.

Amended Version Gives Inadequate Relief

A slight liberalization of the tax laws as they relate to mineral exploration was approved by the House shortly before adjournment. The bill was an amended version of H. R. 4251 by Representative Baker.

As introduced, the measure would have permitted taxpayers to deduct up to $100,000 per year (without limitation as to the number of years) for amounts spent in minerals exploration. However, the Ways and Means Committee amended the bill to retain the present over-all limitation of $400,000 per taxpayer, but to permit taxpayers to spread this sum over any number of years instead of at the rate of $100,000 a year for four years as provided in the present law.

Mining men feel that the measure, as amended and passed by the House, fails to give the necessary relief. They hope that the Senate Finance Committee will restore the original provisions of the bill when considering it at the next sesson of Congress.

Lead-Zinc Study Is Expanded

In compliance with Senate Resolution 162, the United States Tariff Commission has instituted a general investigation of the domestic lead and zinc industry to supplement the findings of a similar study completed in 1954. The report is to be submitted by March 31, 1960.

The Senate resolution directed the commission to include in its report specific findings as to what additional import restrictions, if any (by way of increased duties or import quotas, or both), need to be imposed on lead and zinc, and fabricated products thereof, "in order that lead and zinc mining operations in the United States may be conducted on a sound and stable basis."

The new survey, which will cover lead and zinc articles now subject to import quotas, is an expansion of a study of non-quota lead and zinc articles initiated by the commission early in August. Public hearings have been scheduled to start January 12.

Revision In Barter Program Reported

New rules announced by the Department of Agriculture have removed eight nations from the list of those eligible to trade minerals for specified surplus commodities. These countries—Belgium, Britain, Canada, Japan, Luxemburg, Netherlands, Switzerland, and West Germany—have been determined to be fully able to pay for United States farm products in dollars or other "hard" currencies.

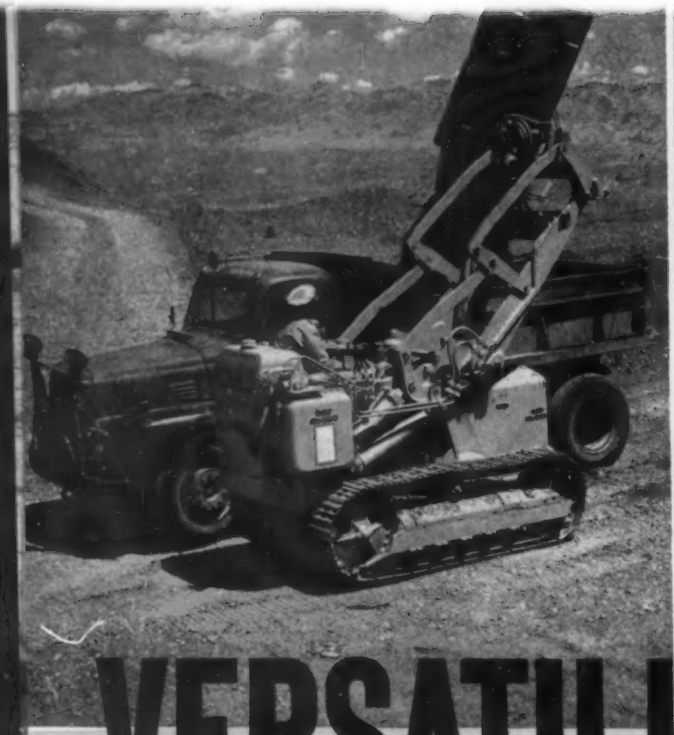
Department officials commented that the change "could result in a reduction" in new barter contracts to be signed in the fiscal year ending next June 30. In the last fiscal year, approved barter contracts involved $158.1 million of farm surpluses.

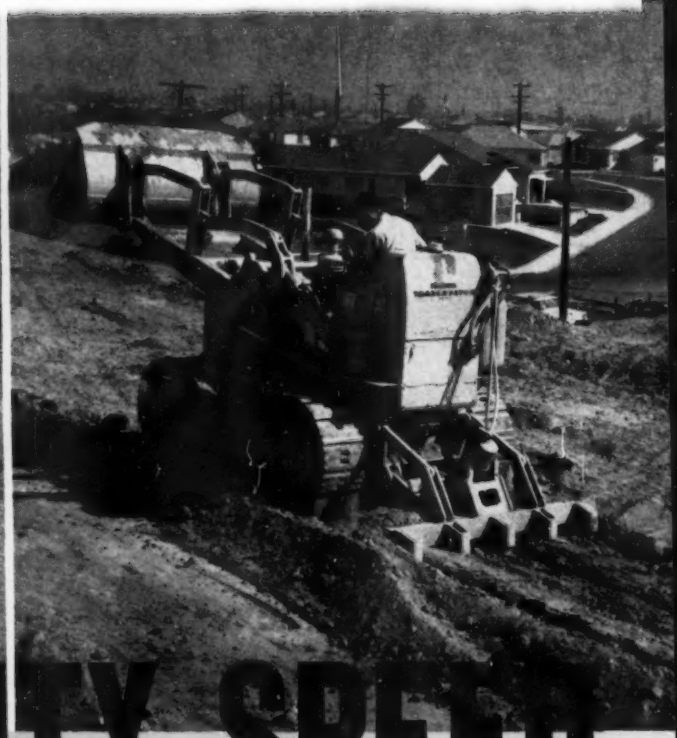
Additional Manganese Funds Denied

The Senate Appropriations Committee, in approving a supplemental appropriation bill, rejected the request of several Senators for the inclusion of $23,000,000 to continue the government's carlot manganese purchase program. The committee's report stated:

"This program has been carried out under the provisions of the Defense Production Act of 1950, as amended, pursuant to a directive of the Director of the Office of Defense Mobilization dated June 27, 1956, which extended the program until January 1, 1961, or until 28,000,000 long-ton units had been delivered. . . . The Office of Civil and Defense Mobilization and the General Services Administration have advised the committee that the maximum defense stockpile objectives for manganese have been met and that there is no authority of law to continue the program under the provisions of the Defense Production Act, as amended. Therefore, the committee has not recommended the allowance of any funds to continue the program."

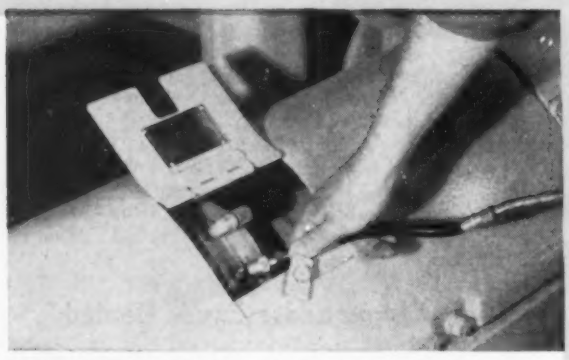
The carlot manganese program was terminated August 5.



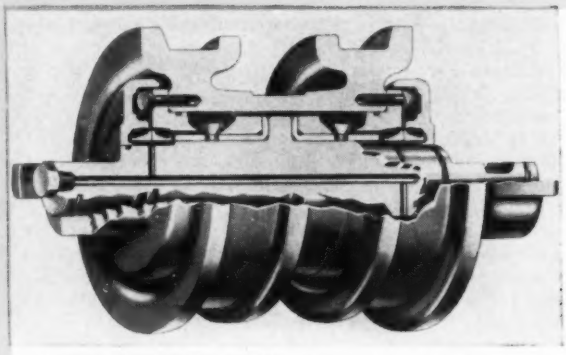


VERSATILITY SPEED

ADD UP TO TOP PRODUCTION

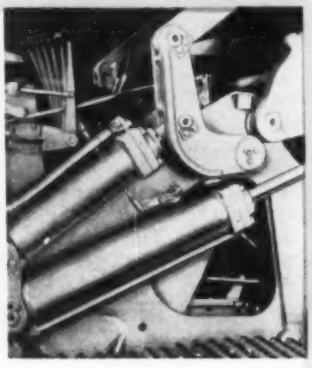


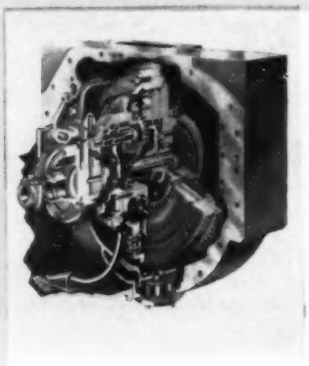
HYDRAULIC TRACK ADJUSTERS standard on the No. 977 and No. 955 —optional on the No. 933. An ordinary grease gun is all that's needed to adjust tracks. Just open the inspection door and apply a few strokes. The hydraulic cylinder does the rest.



LIFETIME LUBRICATED ROLLERS. They need no lubrication servicing until rebuilding. Heat-dissipating oil lubricant is retained by dirtproof floating-ring seal. Eliminate on-the-job roller lubrication. Keep machines on-the-go for longer periods of time.

SMOOTH-FLOW BUCKET CONTROL LEVER. The inside lever is pulled back, lifting the load. It locks in this position until it is kicked out at maximum height by the lift cylinder and linkage. After dumping, both levers are pushed forward. The bucket lowers but only tilts back to an adjustable, preset digging position. Linkage then kicks the outside lever, stopping the bucket tilt.





EXCLUSIVE CATERPILLAR OIL CLUTCH . . . the most advanced clutch design ever offered. Provides up to 2,000 hours without adjustment. This is equal to about 12 months of "adjustment-free" operation. And because wear rate of clutch facing is so slight, down time for clutch repair is almost eliminated.

DEPENDABILITY

IN A TRAXCAVATOR

WHATEVER THE JOB ... whatever the conditions ... there's a Caterpillar-built Traxcavator to take charge. Advance design has given this machine a reputation for speed ... efficiency ... low operating and maintenance costs. For this is a digging and loading tool; not a tractor attachment.

The line is complete. You get top production from three Traxcavators ... the No. 933—52 HP, 1⅛ cu. yd. bucket; the No. 955—70 HP, 1½ cu. yd. bucket; the No. 977—100 HP, 2¼ cu. yd. bucket. And there's a complete range of quick-change attachments ... special buckets, bulldozers, forks, the exclusive side dump bucket and the rear-mounted ripper.

Traxcavators are built to last. They have a heavy steel main frame, welded into a one-piece unit. Box construction track roller frame absorbs the loads and stresses of tough treatment. Lift arms are made to stand up under the strain of heaviest digging conditions.

Traxcavators give you fast action and ease of operation. Excellent stability and balance give better control of the machine. A fast hydraulic system cuts cycle time and increases maneuverability even in close quarters. Visibility is excellent. The high seat puts the operator on "top" of the work. Operator's compartment is uncluttered. Tractor controls are conveniently located for handling ease. Bucket controls are at the right armrest ... closely spaced for dual operation with one hand.

The reliable Caterpillar Diesel Engine has a fuel-saving injection system and ability for hard lugging. Each engine is matched to the machine for power and bucket size.

All of these features pay off in top production. Let your Caterpillar Dealer help you choose the Traxcavator best suited for your job. Get production facts and figures. And ask for a demonstration.

Caterpillar Tractor Co., San Francisco, Cal.; Peoria, Ill., U.S.A.

CATERPILLAR

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

BOOST PRODUCTION AND LOWER COSTS WITH A VERSATILE TRAXCAVATOR

KW-DART 40T
450HP — 40 Ton Payload

with TIME and POWER to spare

When the KW-DARTS come roaring out of the pit, there's lots of power left over. Every KW-DART is job engineered — with combinations of components matched to do the job faster and easier. That's why KW-DARTS perform better . . . for lower maintenance costs . . . and for longer service life.

There are KW-DART sales engineers near you who can analyze your specific needs. Your phone call or letter will bring an immediate response.

KW-DART TRUCK CO.

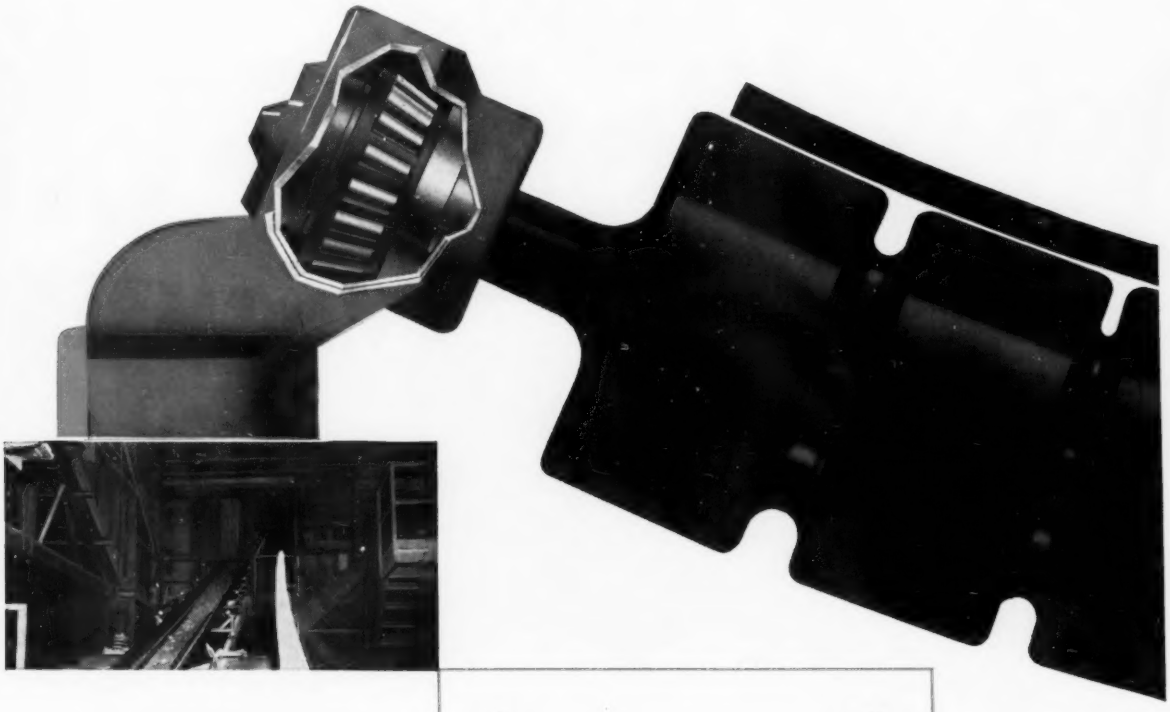
Subsidiary of Pacific Car and Foundry Company

1301 North Manchester Trafficway
Kansas City 41, Missouri, U.S.A.

P.O. Box 321

152

Bearing Location is the Key to Long Service Life



JOY LIMBEROLLER® CONVEYOR IDLERS

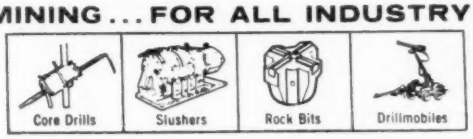
Joy Limberoller Conveyor Idlers give many times the normal service life, because the two bearings rest in slots in the support brackets—well away from spillage. On conveyor lines carrying ore, crushed rock, and other abrasive materials, Limberollers have given more than ten times the service life of steel idlers.

Limberoller Idlers consist of a neoprene coated wire rope to which are moulded neoprene discs. The ends of the rope turn in sealed bearings. This design not only eliminates clogging and freezing of the bearings, but also makes the idlers easy to service—they can be replaced while the belt is moving.

Limberollers are economical, not only because of long service life, but also because they can be spaced further apart than steel idlers. They are corrosion and flame resistant, self-cleaning, and eliminate the "bump" typical of steel idlers.

For complete details, write for Bulletin 358-8.

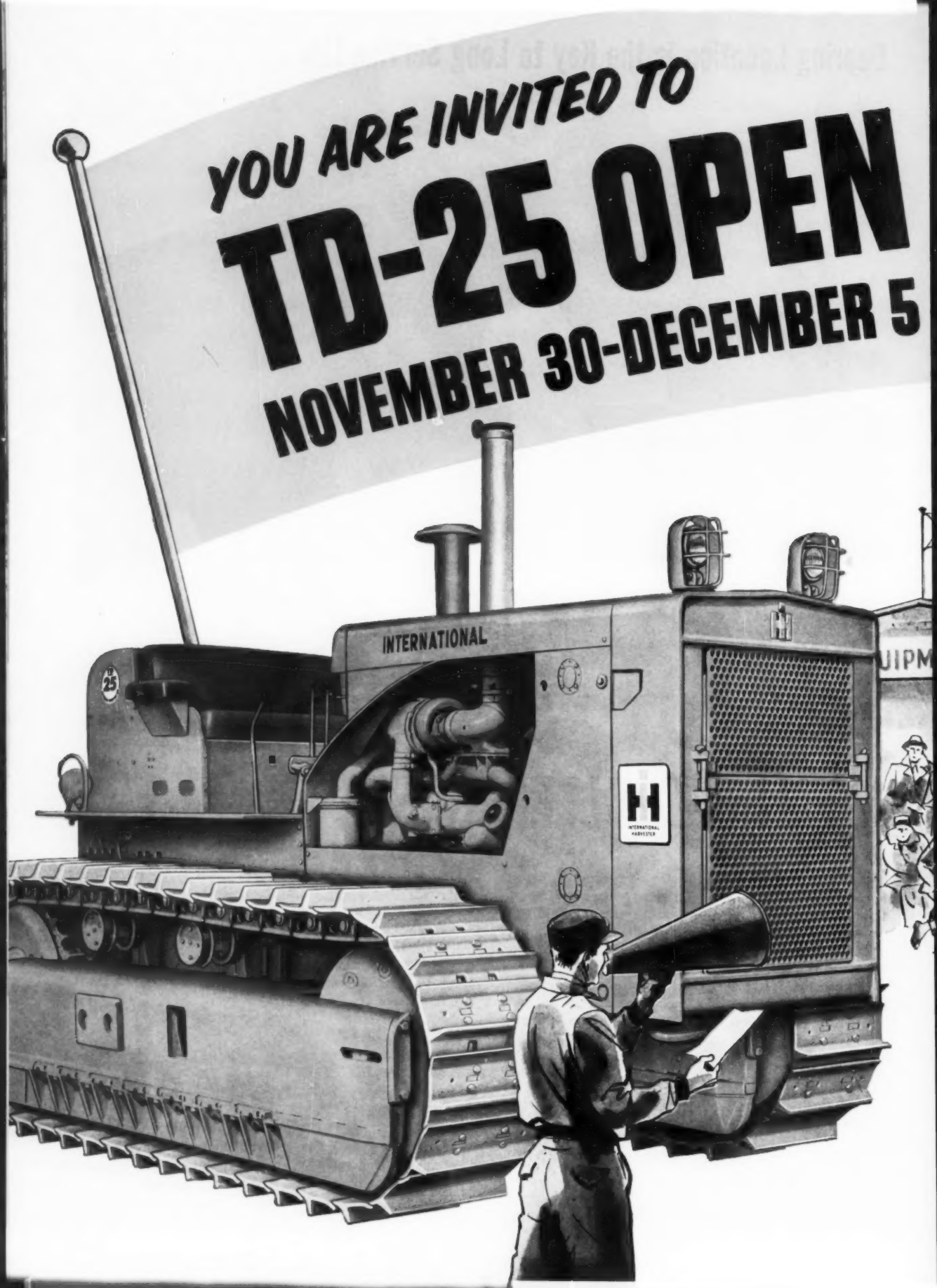
EQUIPMENT FOR MINING ... FOR ALL INDUSTRY



JOY

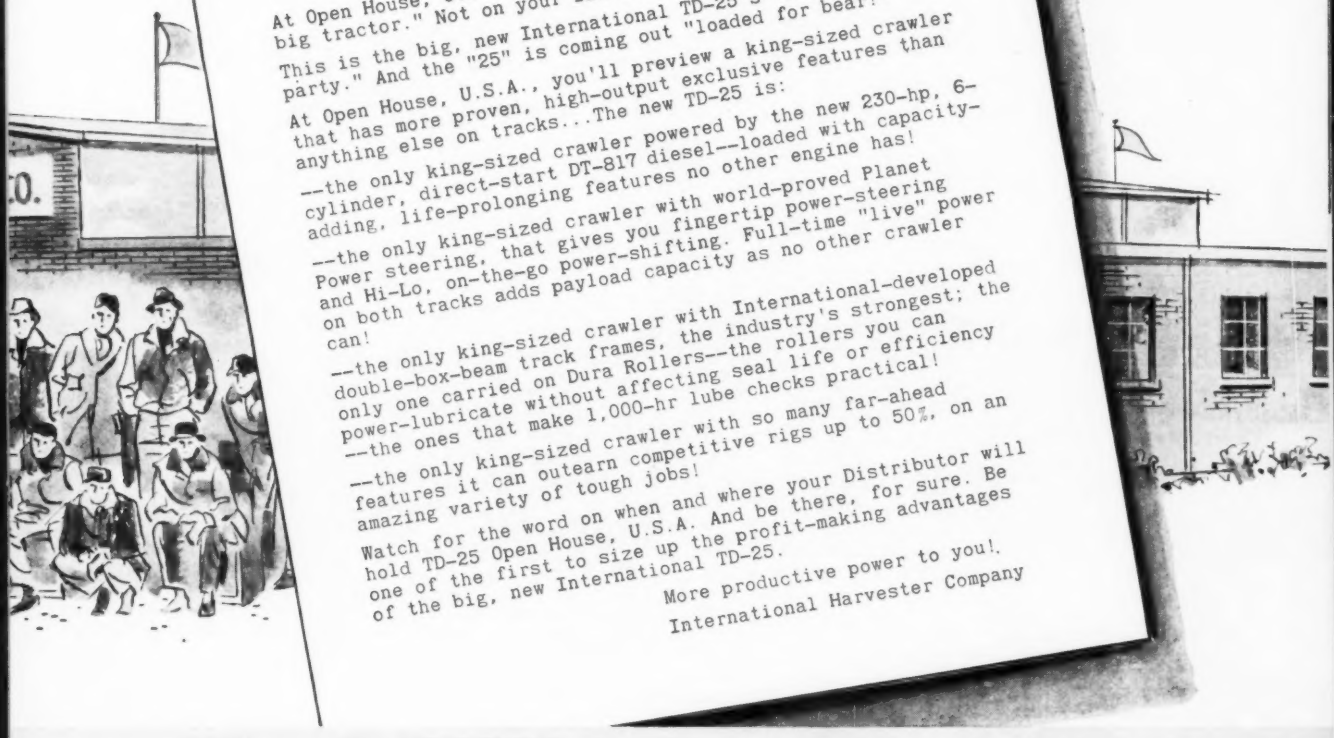
Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario



DENVER adjustable stroke

HOUSE, U.S.A.



INTERNATIONAL HARVESTER COMPANY
180 NORTH MICHIGAN AVENUE • CHICAGO 1, ILLINOIS

An open invitation to profit-conscious contractors

At Open House, U.S.A., you won't be viewing "just another big tractor." Not on your life!

This is the big, new International TD-25's "coming out party." And the "25" is coming out "loaded for bear!"

At Open House, U.S.A., you'll preview a king-sized crawler that has more proven, high-output exclusive features than anything else on tracks...The new TD-25 is:

--the only king-sized crawler powered by the new 230-hp, 6-cylinder, direct-start DT-817 diesel--loaded with capacity-adding, life-prolonging features no other engine has!

--the only king-sized crawler with world-proved Planet Power steering, that gives you fingertip power-steering and Hi-Lo, on-the-go power-shifting. Full-time "live" power on both tracks adds payload capacity as no other crawler can!

--the only king-sized crawler with International-developed double-box-beam track frames, the industry's strongest; the only one carried on Dura Rollers--the rollers you can power-lubricate without affecting seal life or efficiency --the ones that make 1,000-hr lube checks practical!

--the only king-sized crawler with so many far-ahead features it can outearn competitive rigs up to 50%, on an amazing variety of tough jobs!

Watch for the word on when and where your Distributor will hold TD-25 Open House, U.S.A. And be there, for sure. Be one of the first to size up the profit-making advantages of the big, new International TD-25.

More productive power to you!.

International Harvester Company

International® Construction Equipment

International Harvester Co., 180 North Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

DENVER adjustable stroke DIAPHRAGM PUMPS

NOW...Smaller Pumps That Do As Much As Larger Pumps Used To Do!

For example:

3" DENVER Pump..... 45 GPM capacity
4" Other Pumps..... 45 GPM capacity

Now you get the capacity of the larger pump, plus line velocity engineered to keep solids from settling. Feed line velocity is uniform throughout the complete line of DENVER Pumps.

You save on initial cost—on maintenance. You get simple, compact design—rugged dependability.

Buy Your Pump by Capacity—Not Size!

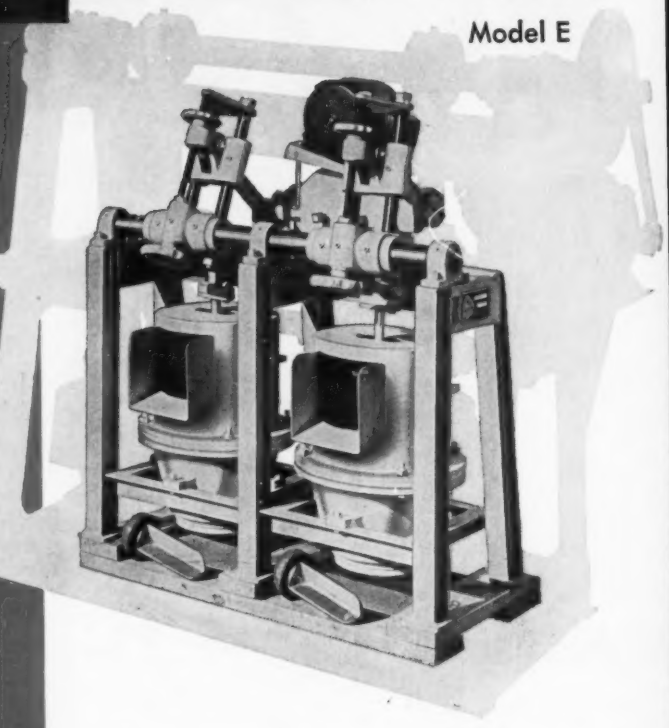
Table below shows new capacities of DENVER Pumps by size. Compare with the pumps you may now be using. Why pay more for a bigger pump when a smaller DENVER Pump will do as much? Determine the capacity required for your operation—then select the pump that does the job.

NEW DENVER ADJUSTABLE STROKE DIAPHRAGM PUMPS

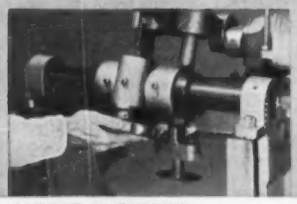
DENVER Pump Size	Capacity—GPM* SIMPLEX	DUPLEX	Line Velocity At Listed Capacities
2"	20	40	2.00 ft./sec.
3"	45	90	2.00 ft./sec.
4"	70	140	2.00 ft./sec.
5"	120	240	2.00 ft./sec.
6"	175	350	2.00 ft./sec.
8"	320	640	2.00 ft./sec.
10"	500	1000	2.00 ft./sec.

*at maximum stroke and normal speed. Stroke can be adjusted *while pump is operating.*

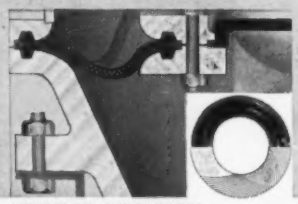
Model E



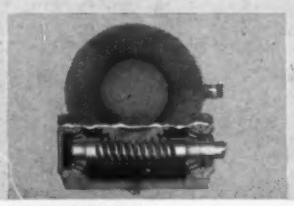
Sizes from 1" to 10", simplex and duplex, in capacities up to 1000 GPM—standard or acid-proof construction.



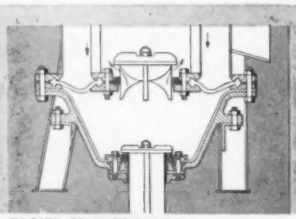
POSITIVE ADJUSTMENT and control are made while pump is operating by turning conveniently located handwheel. Improved design permits longer strokes, greater capacity.



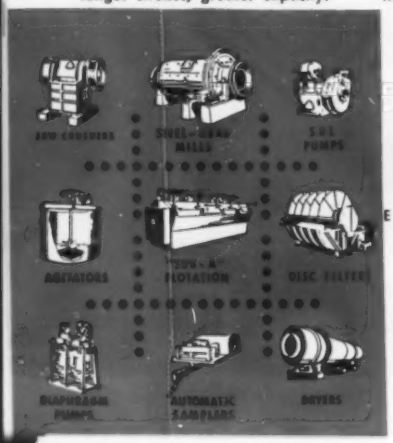
IMPROVED DIAPHRAGM is rubber, molded with patented spiral nylon cord construction to withstand constant flexing and permit longer stroke that boosts capacity up to 75%.



POWER ECONOMY results from anti-friction bearing design and simplified, efficient, running-in-oil drive. Reduces maintenance, assures long, trouble-free operation.



EASIER MAINTENANCE provided by simple design and such features as long wearing tough rubber valve seats that can be quickly and easily replaced.



"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEERS — STANDARD RELIABLE 24 HOUR SERVICE EFFICIENT

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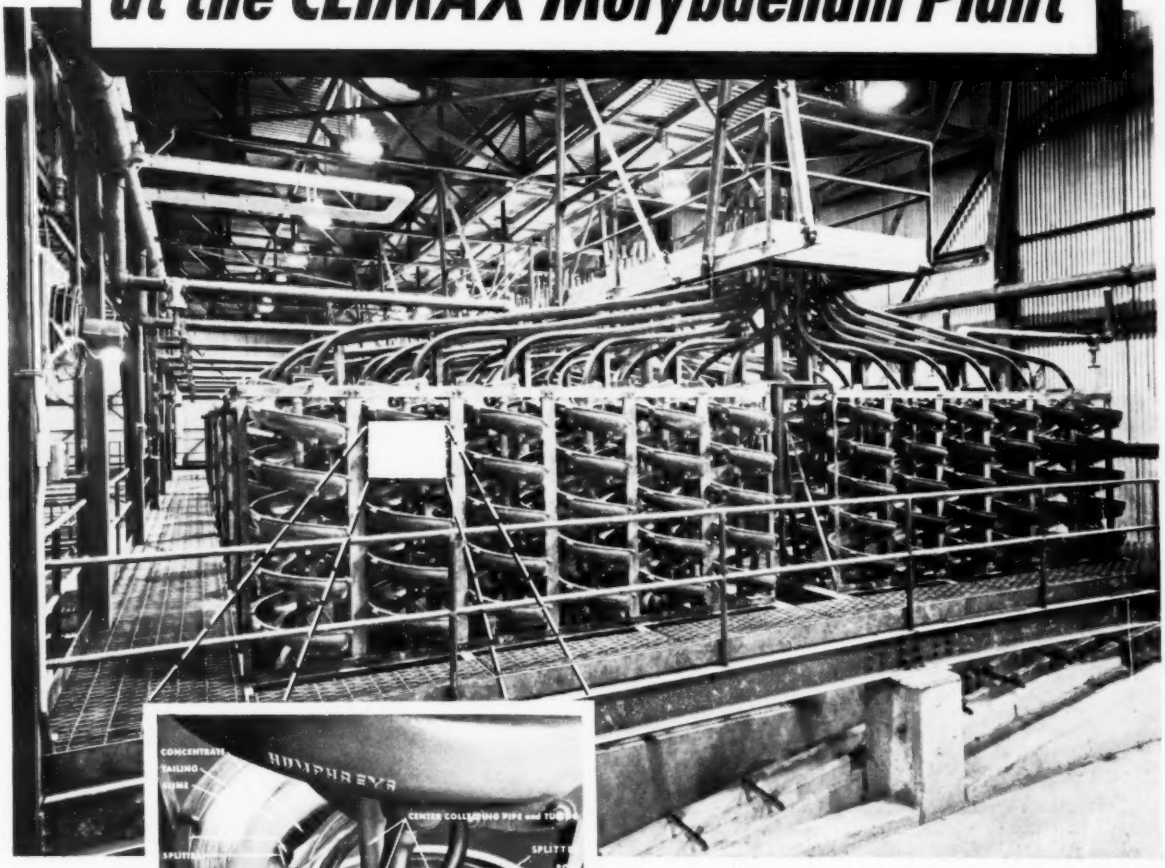
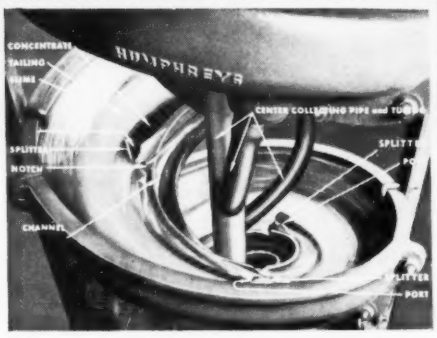
Phone 211477

LIMA
AVDA Orrantia 1570
San Isidro

HUMPHREYS Spiral Concentrators *at the CLIMAX Molybdenum Plant*





Since 1946, when test work was started with Humphreys Spirals, our engineers have worked closely with Climax engineers to develop efficient, successful, lowest cost separation of minerals. Such individual, specialized engineering consultation is a key part of our service.

Write today for information . . .

HUMPHREYS ENGINEERING CO.

SUITE 910, 818 17th St. DENVER, COLORADO

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JOHN CARRUTHERS & CO. PTY. LTD.
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SHATTUCK DENN

offsets rising costs with improved Cyanamid Reagent Combinations

At its Humboldt, Arizona Iron King Mill, Shattuck Denn Mining Corporation treats 1000 tpd of a complex, fine-grained sulfide ore by flotation and cyanidation to recover lead, zinc, gold and silver plus a small amount of copper. While this is primarily a lead-zinc operation, recovery of gold occurring in the pyrite and silver occurring in tennantite is important to profitable operation. Heads average about 50% pyrite, and contain 8-9% Zn, 2.5-3% Pb, in addition to gold and silver values.

In 1942 Shattuck Denn evolved an "index of economic recovery" for evaluating daily metallurgical results from five pay metals recovered with two differential flotation operations and subsequent cyanidation of the flotation tails with AERO® Brand Cyanide. The index compares actual returns with the theoretical maximum dollar return based on current metal prices, freight and treatment charges.

Rising costs have compelled constant study and revision of reagent combinations. But, because of improved metallurgy and milling equipment, zinc economic return now exceeds the theoretical maximum economic recovery. Recently, reagent changes again improved metallurgy and dollar return, as reported by the Cyanamid Field Engineer working on the job with Shattuck-Denn metallurgists:

"SODIUM AEROFLOAT® Promoter has replaced potassium ethyl xanthate in the zinc circuit. AEROFLOAT® 208 Promoter, AERO® Xanthate 301 and AERO® Depressant 620 have replaced AERO® Promoter 404 and potassium ethyl xanthate in the lead circuit."

"As a result, the economic recovery index for the first six months of 1959 is 12.3% better than the figure for the year 1956. Particularly noteworthy is a 26% increase in economic recovery in the zinc circuit, due primarily to the use of SODIUM AEROFLOAT Promoter. Reagent changes in the lead circuit have also improved lead concentrate grade and lead recovery."

An important part of the extra value received by users and prospective users of Cyanamid reagents are the services of Cyanamid Field Engineers backed by the Cyanamid Mining Chemicals Laboratory. The nearest Cyanamid Field Engineer will be glad to work with you in using Cyanamid reagents to help you try to cut costs and improve metallurgy.

HOW MARCY EXPERIENCE

REAGENTS, LB/TON, PRESENT

Ball Mill		Pb Circuit		Zn Circuit	
AERO Brand Cyanide	0.73	AERO Xanthate 301	0.05	CaO	2.2
$ZnSO_4$	0.88	Cresylic Acid	0.01	$CuSO_4$	2.1
AEROFLOAT 208	0.05	AERO Depressant 620	0.015	SODIUM AEROFLOAT	0.18
				Cresylic Acid	0.02

REAGENTS, LB/TON, PREVIOUS

Ball Mill		Pb Circuit		Zn Circuit	
AERO Brand Cyanide	0.62	K Ethyl Xanthate	0.02	CaO	2.3
$ZnSO_4$	0.79	Cresylic Acid	0.05	$CuSO_4$	2.4
AERO Promoter 404	0.04	Methyl Isobutyl Carbinol	0.04	K Ethyl Xanthate	0.25
				Cresylic Acid	0.01

RESULTS

	Present, 6 mos. 1959	Previous, Year 1956
Overall Economic Recovery	83	70.7
Zinc Economic Recovery	100	74
Pb Concentrate, % Pb	32.8	26.4
Zn Concentrate, % Zn	56.3	50.4

AMERICAN CYANAMID COMPANY

EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

CYANAMID

CYANAMID INTERNATIONAL—*Mining Chemicals Department*
Cable Address:—Cyanamid, New York

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Why pivot steer hauler

HOW MARCY EXPERIENCE

WITH 2-STAGE GRINDING

Increases tonnage at lower cost

Mine and Smelter has specialized in the design, manufacture and application of Marcy Mills since 1915. The extensive research and experience during this time has resulted in many refinements in the grinding process. One of the most significant developments is 2-stage grinding.

Experience has proved two successful ways of using Marcy Open End Rod Mills for 2-stage grinding...

1. By addition of a grinding stage

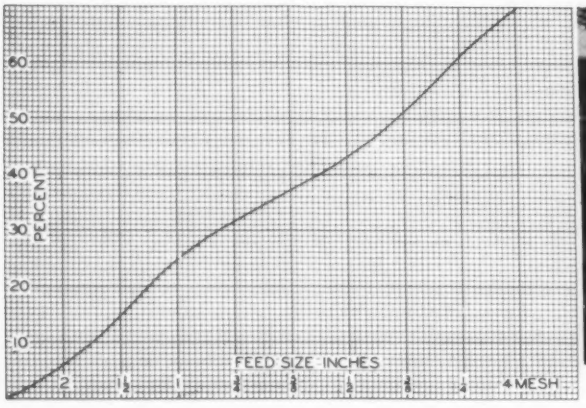
Adding Marcy Open End Rod Mills between existing crushing and grinding circuits...

- Permits larger size crusher discharge, thus greatly increases crushing capacity
- Rod mill can take 1" feed and produce a higher percentage of finished product than crusher
- Rod mill provides finer feed for ball mills, increasing their capacity
- Permits recovery of liberated mineral at coarser size

2. By replacing fine crushing

Replacing fine crushing with Marcy Open End Rod Mills gives all the advantages listed under No. 1, in addition to eliminating the high operating and maintenance costs of complex circuits of crushers, rolls, screens, elevators, etc.

Operating experience has proved that use of Marcy Open End Rod Mills for 2-stage grinding will increase tonnage at lower overall cost per ton



This graph shows increase in mill capacity with decrease in size of feed. For example if a rod mill was used to decrease ball mill feed from 1" to 4 mesh the ball mill capacity would be increased 45%.

This large copper company installed a 9½' x 12' Marcy Open End Rod Mill in parallel with its 2-stage roll-screen circuit. As a result of this test 17 Marcy Rod Mills were installed to replace all roll-screen circuits. Rod Mill feed is 1½" hard ore; grind is to 4% + 10 mesh; tonnage up to 2700 tons per day, each mill. They reduced costs and improved operating conditions.

FOR ACTUAL OPERATING DATA ON 2-STAGE GRINDING WRITE, WIRE OR CALL

Manufacturing Division

MINE AND SMELTER SUPPLY CO.

DENVER 16	NEW YORK 17	SALT LAKE CITY 1	EL PASO
3800 RACE STREET	122 E. 42nd STREET	121 W. 2nd S.	1515 11th AVE.

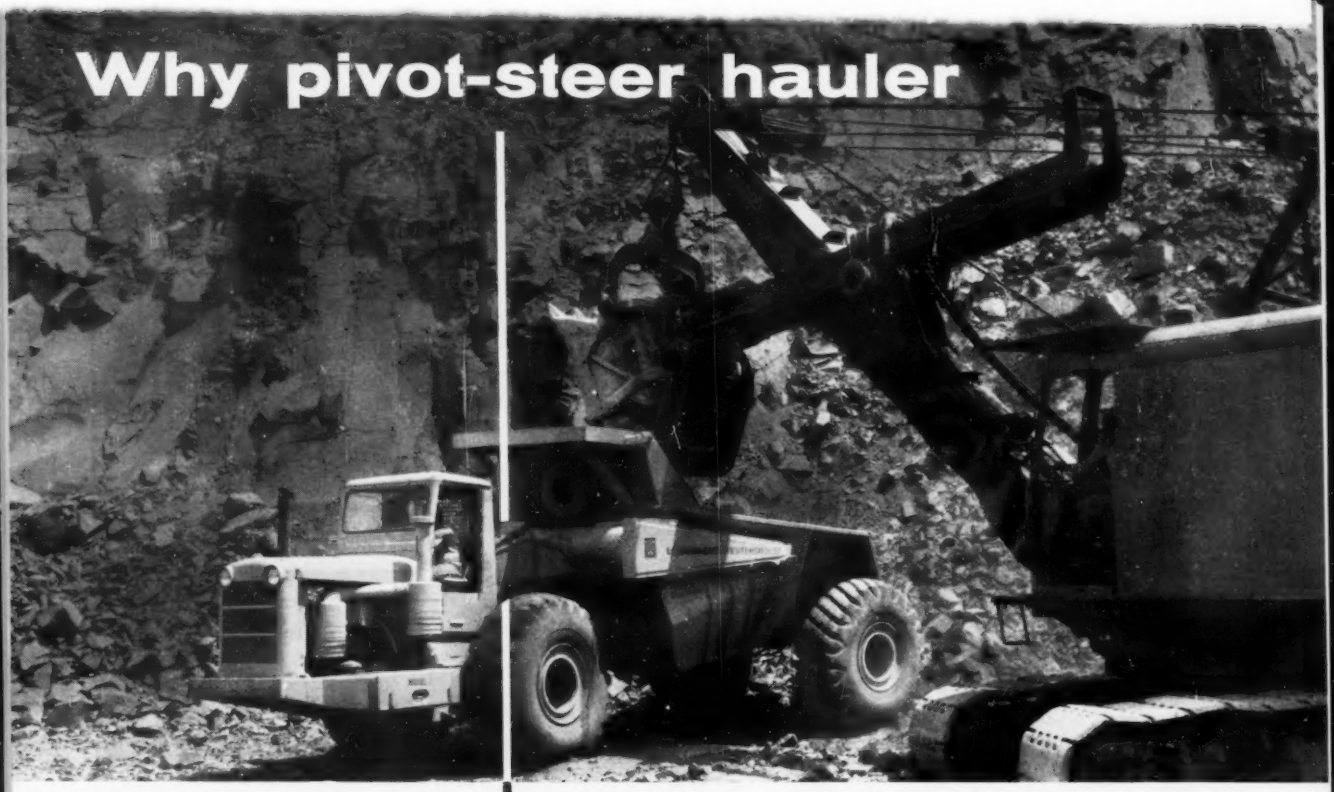
LICENSED MANUFACTURERS AND SALES AGENTS in Canada, Australia, Sweden, England, South Africa

SALES AGENTS in Peru, Chile, Philippine Islands, Japan, New York City (for Continental Europe) and in principal cities of the U. S.

Cable Address:—Cyanamid, New York

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Why pivot-steer hauler



cuts equipment downtime... boosts pit output... lowers handling costs...

Rugged, simplified construction is one big reason why speedy LeTourneau-Westinghouse Tournapull® Rear-Dumps keep working efficiently day after day . . . year after year . . . to help pit owners cut costs. Notice that on this machine there are no springs, no tie rods, no hose and pipe lines, no frame, no long drive-shaft to require maintenance and repair.

In place of a foundation frame and body sub-frame, Tournapull prime-mover and trail-unit are hitched together by means of a high horizontal yoke. Yoke pivots horizontally on kingpin at front . . . then extends back along side of bowl, where it pivots vertically just above and ahead of rear wheels. This unique vertical and horizontal kingpin arrangement also provides an easy oscillating action that eliminates most twisting, tilting strains . . . permits higher working speeds on uneven ground to boost pit output.

Resists heaviest loading jolts

Shovel operator does not have to move slowly when loading heavy materials. L-W Rear-Dump bowl is all steel—no wood fillers. Triple-layer floor is lined with heat-treated tool-steel strips, welded to solid billets laid over heavy steel plate. Sloping sides deflect load shock, quickly cushion floor area with layer of material to minimize rock damage.

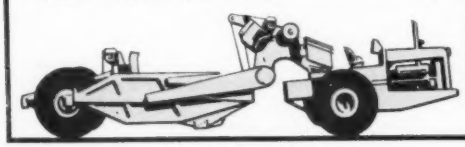
Tire, clutch, transmission wear reduced

Costly wear on tires, clutch, and transmission caused by spinning wheels in slippery or loose footing, is minimized with Tournapull Rear-Dump. When either powered wheel begins to spin, unit's exclusive L-W power-transfer differential automatically diverts up to 80% of power to drive wheel on firmest footing. Also, electric 90° pivot-turn through geared kingpin, lets operator pivot prime-mover out of mud or loose sand. Dumping action can also be used to "push" empty hauler off a soft bank.

Features likes these—plus full 90° turns, efficient electric-controls, fast, clean dump, giant air brakes, excellent visibility—add up to high production and low costs. Let us show you a LeTourneau-Westinghouse Tournapull Rear-Dump in action. Available in 3 sizes: 11, 22, and 35 tons.

Bonus interchangeability feature

For less than ¼ the cost of an L-W Tournapull prime-mover with Rear-Dump, you can get an easy-loading L-W scraper to interchange with original Rear-Dump trail-unit. Change-over—using same 2-wheel prime-mover—takes just a few hours. Use scraper to lower dirtmoving costs on stripping operations, haul-road or drainage construction, and for exploratory mining. Other trail-units to increase prime-mover's usefulness also available.



LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

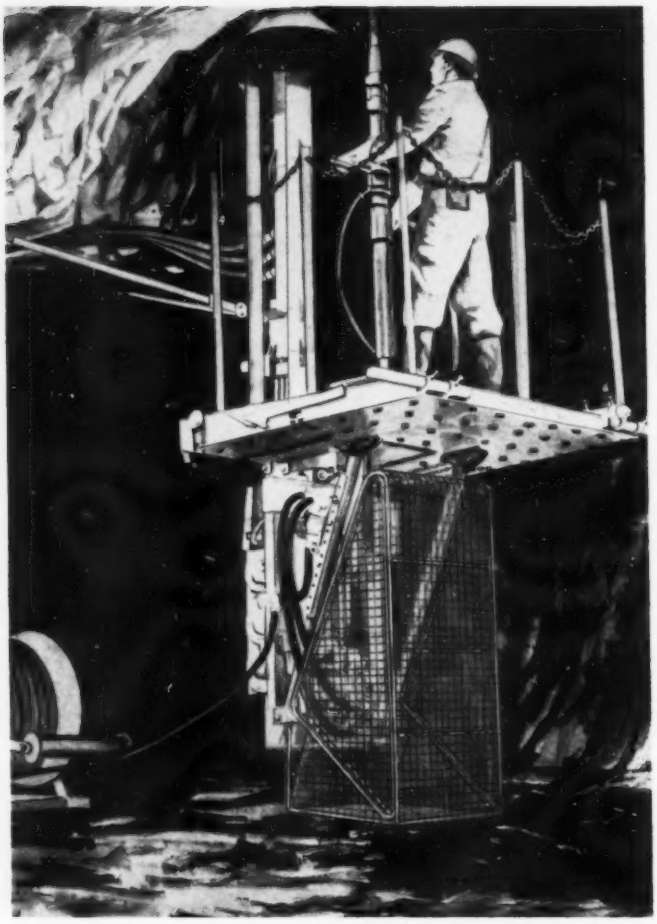
A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

New Speed
New Safety
New Economy

ALIMAK

RAISE-CLIMBER* ELEVATING SYSTEM



Profit moves up when management cuts into drill-blast cycle expense with ALIMAK's *Raise-Climber Elevating System.* Now, one man can carry out a full range of operations, with maximum safety, at the face of the raise—up to 50 percent faster, and up to 50 percent cheaper.

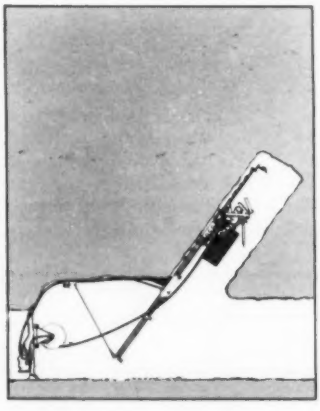
The *Raise-Climber* is equally efficient in either vertical or inclined raises, providing all services—water, air, electricity and telephone, housed in the rack itself – at the operator's finger-tips. The operator is raised to the working face where he drills for charges. After descending, the platform is folded back for blasting, high-pressure clean-out and ventilating. Operating records in nearly one hundred world-wide mining installations, including twelve in Canada, attest to the *Raise-Climber's* remarkable versatility, ruggedness, and simplicity of design.

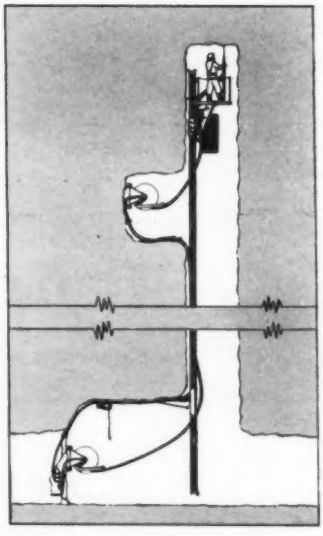
Complete sales and service representation available throughout the United States. Write or wire for full details, today.

*Patent Pending

for driving raises from 40 feet up to 1200 feet and more

Additional 3 ft. or 6 ft. sections are quickly and safely installed from platform. Costly staging and re-staging is eliminated. On raises over 600 ft. added hose reel is installed in niche.





ALIMAK

RAISE-CLIMBER ELEVATING SYSTEM

Alimak Corporation

306 Avila St., San Francisco 23, California
A Subsidiary of Alimak-Verken AB
Skelleftea, Sweden

A Product of Swedish Engineering

The faster you get to a job . . . the quicker you complete it . . . the more return you get on your tractor investment

In less than 4 minutes, a fast LeTournatractor-Westinghouse Tournatractor drives a mile to its next job. This mobile LW tractor travels anywhere under its own power—at speeds to 17 mph—via highway, or cross-country.

When moving to a new project, Tournatractor saves the time, bother, and expense of moving equipment . . . loading, blocking, and unloading.

This 218-hp rubber-tired tractor not only saves time traveling job-to-job . . . it saves time *on the job.* With its higher *working* speeds, both forward and reverse, torque-converter equipped Tournatractor completes most assignments *faster* than crawler-tracked units of comparable power. And the *range* of work Tournatractor will handle is wide. It will do ALL normal dozing, and "push-or-pull" jobs, with all the "muscle" you need.

What these advantages mean to you:

1. Greater speed on the job: completes assignments faster.

2. Roadability: cuts moving costs, and non-pay hours of moving time.

3. Fast one-man moves: lets Tournatractor work more productive-hours per shift . . . lets you handle more work at lower cost.

LW Tournatractor has proved itself in every climate and in all kinds of working conditions. It can save YOU time and money. Full details on this versatile, high-speed tractor-on-rubber will be sent to you promptly when requested.

LW Tournatractor has anti-friction bearings throughout . . . with sealed-in lubrication to protect against weather, dust, and wear. What's more, this rubber-tired tractor has far fewer moving parts and far fewer exposed parts than crawlers, so all phases of maintenance—from inspection to lubrication—are greatly simplified, to save you money.

Tournatractor—Trademark Reg. U.S. Pat. Off. CT-2140-G-1r

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

How AMSCO helps you MOVE

Read why AMSCO Simplex Teeth and hardfacing are first choice of these users

SIMPLEX TEETH STAY SHARP AFTER 20,000 TONS OF DIGGING

AT VICTORVILLE LIME ROCK CO.

At Victorville Lime Rock Co., Victorville, California, four Amsco Simplex 2-Part Reversible Teeth were installed on a shovel used in a stripping operation. Teeth previously used "lost their points" after digging about 18,000 tons of rock... and had to be replaced or rebuilt. The Simplex Teeth have already dug over 20,000 tons. Paul Keating, Quarry Superintendent, expects to get *at least 25,000 tons* before changing teeth.

Wright Smith, operator of the strip shovel, is equally enthusiastic about Simplex Teeth. He says they can lose more than 2" due to wear, and still hold their points. This means lower cost operation and fewer shutdowns for maintenance. Old-style teeth had to be sent out for welding when worn down a couple of inches.

Victorville Lime Rock Co. produces a pure white lime rock used as an extender or filler in paints, plastics, floor tiles, rubber, ceramics, etc. They operate a 100 ft. deep quarry, and plan to switch to Simplex Teeth on their other production shovels, too, in order to save on maintenance costs.

AMSCO HARDFACING ELECTRODES PROVE BEST FOR BUILD-UP JOBS

AT BAY CONTRACTORS WELDING SERVICE

"Amsco AW-79 wire doesn't twist and gives an excellent, uniform bead" —says Peter Agresta, partner in Bay Contractors Welding Service, El Cerrito, California. He also adds that AW-79 gives service life equal to, or better than, any wire they've ever used.

As a result, Bay Contractors uses Amsco AW-79 (a highly quality-controlled tubular rod) for just about every type of build-up job... except where surfaces require machining.

For example, they use it for build-up of diesel switcher wheels... crawler tractor rollers and idlers... shovel rollers and front take-up rollers... house carrier rollers... sheaves... cutting edges on all alloyed blades.

For further information:

SIMPLEX TEETH – see your power shovel equipment dealer, or write Amsco for technical bulletin.

HARDFACING ALLOYS – see your Amsco welding distributor, or write direct for Condensed Catalog and Price List.

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

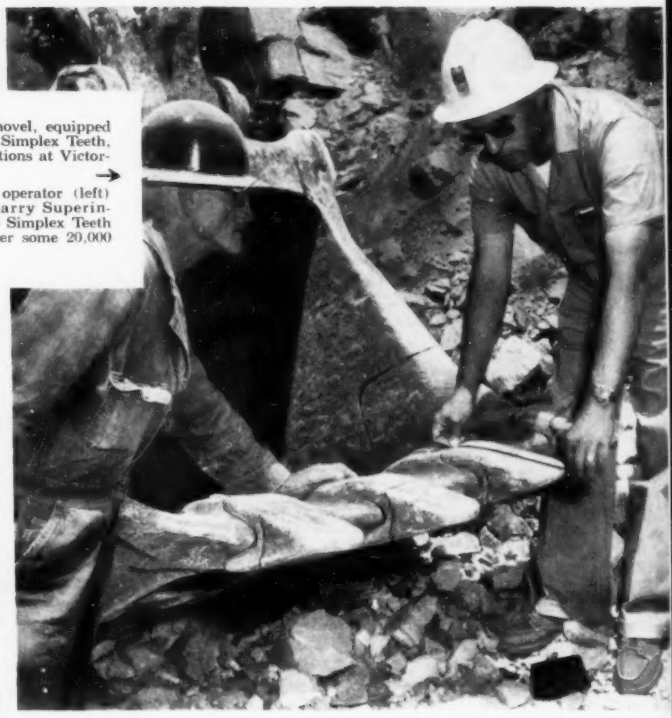
Other plants in: Denver • Los Angeles • New Castle, Dela. • Oakland, California • St. Louis
In Canada: Joliette Steel and Manitoba Steel Foundry Divisions
Welding products distributed by Canadian Liquid Air Co., Ltd.

AMERICAN Brake Shoe COMPANY

MORE TONS PER DOLLAR

← Northwest Model 6 shovel, equipped with Amsco dipper and Simplex Teeth, used for stripping operations at Victorville Lime Rock.

Wright Smith, shovel operator (left) and Paul Keating, Quarry Superintendent (right) examine Simplex Teeth on Amsco dipper . . . after some 20,000 tons of digging. →



→ Peter Agresta, of Bay Contractors Welding Service, uses automatic machine of own design to build-up tractor idler.

← Build-up of crusher jaw plate is demonstrated by a Bay Contractors' welder . . . Manganese rounds are first tack-welded across surface of plate with Amsco Nicro-Mang. Amsco Manganese Rod is used in the Amsco semiautomatic machine to build-up plate to original cross-section. The plate is then straightened by a special process.

or HERE...

SUPER SERVICE

is the quality standard for portable power and mining cable

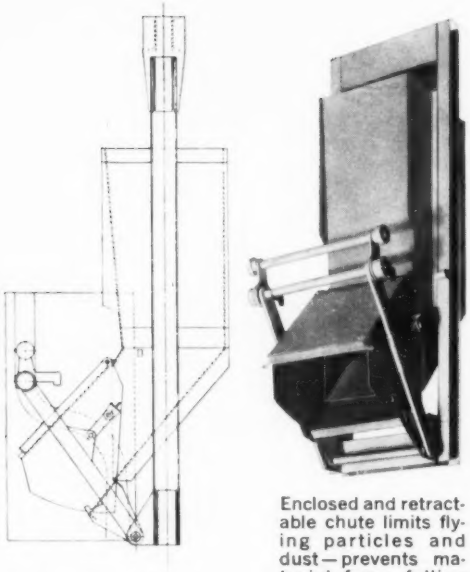
Aboveground or underground, no other portable cable exceeds General Cable's *Super Service* in durability and long service life! Wear, cutting, abrasion and other mechanical abuse are shrugged off by the mold-vulcanized neoprene *Supertuf* sheath. Unbeatable resistance to water, oil, acids, alkalis, flame, sunlight and weathering. And double-layer cord reinforcement adds extra mechanical strength. *Super Service* is available in a *complete line* from 600 V to 15 KV.

GENERAL CABLE CORPORATION,
730 Third Avenue, New York 17, New York
Offices and Distributing Centers Coast-to-Coast

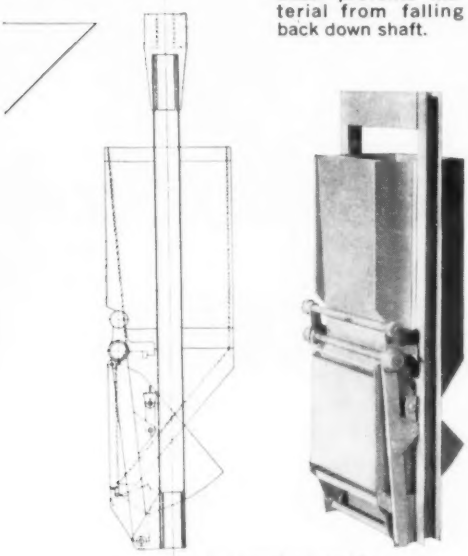
for quality and service...specify **GENERAL CABLE**

Door pivots from top in new front discharge skip

ACTIVATED BY TOGGLE LINKAGE SYSTEM



Enclosed and retractable chute limits flying particles and dust—prevents material from falling back down shaft.



In carrying position door is squeezed closed against rubber seal—locked in position—safety hook locks dump roller in position.

Lake Shore's new front discharge skip is similar in general construction to the Anaconda and other front dump skips. The unit differs in that the door pivots from the top and is actuated by a toggle linkage system that gives the same desirable door operating features as Lake Shore's famed "Jeto" Skip. The door is closed against the rubber seal by means of the toggle linkage and mechanically locked in position. This eliminates all possibilities of spillage and makes the skip completely watertight. The main dump roller is locked in position by a safety hook actuated by another pair of rollers above the main dump rollers. This insures positive locking and complete protection against possible opening in the shaft.

An enclosed chute extension from the skip in the opened position, limits flying particles and dust problems during dumping. Also, a retractable chute extends over the bin during dumping, thus preventing material from falling back down the shaft. On average sizes the skip can dump within three feet vertical travel after the skip has entered the dump scrolls. This is possible because during the major portion of the door opening the pressure of the load against the door helps it to open.

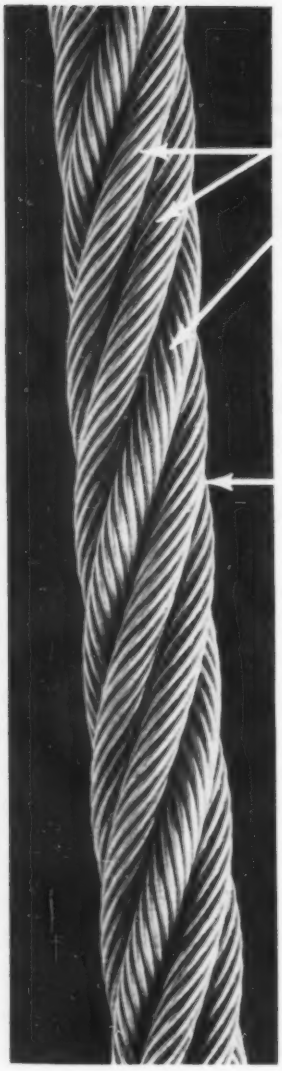
This latest development by Lake Shore provides the mining industry with a clean, fast dumping front dump skip that produces minimum reaction on the headframe while dumping.

Patents Pending

LAKE SHORE, Inc.

IRON MOUNTAIN, MICHIGAN

controlled metal hardness means



Herringbone's two pairs of Lang lay strands and one pair of regular lay strands provide the ideal combination of maximum flexibility with good stability.

Finer wires inside contribute to Herringbone's excellent drum-winding characteristics.

Heavier outside wires in each strand have greater resistance to abrasion.

"Herringbone* saves our equipment"

AMICO SAND AND GRAVEL COMPANY

Read this about the most exciting wire rope development in years . . . "Turning a profit on any product often boils down to something that will do a specific job better than anything else. Our equipment operators prefer Roebling Herringbone to any other for heavy lifts, clam shell, drag, pan work or dozers. The savings on sheaves, because of Herringbone's perfect tracking, are a big item as far as we are concerned."

Amico Sand and Gravel Company, Morrisville, Pennsylvania, and Riverside, New Jersey, has told you what this combined regular lay and Lang lay rope—two-ropes-in-one—is doing for them. Roebling is in a position to *show* you how the new Herringbone can, again, in the words of Amico ". . . give you a chance to turn more profit on production equipment." Write to Wire Rope Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey, for the full and fabulous facts.

*Reg. App. For

ROEBLING

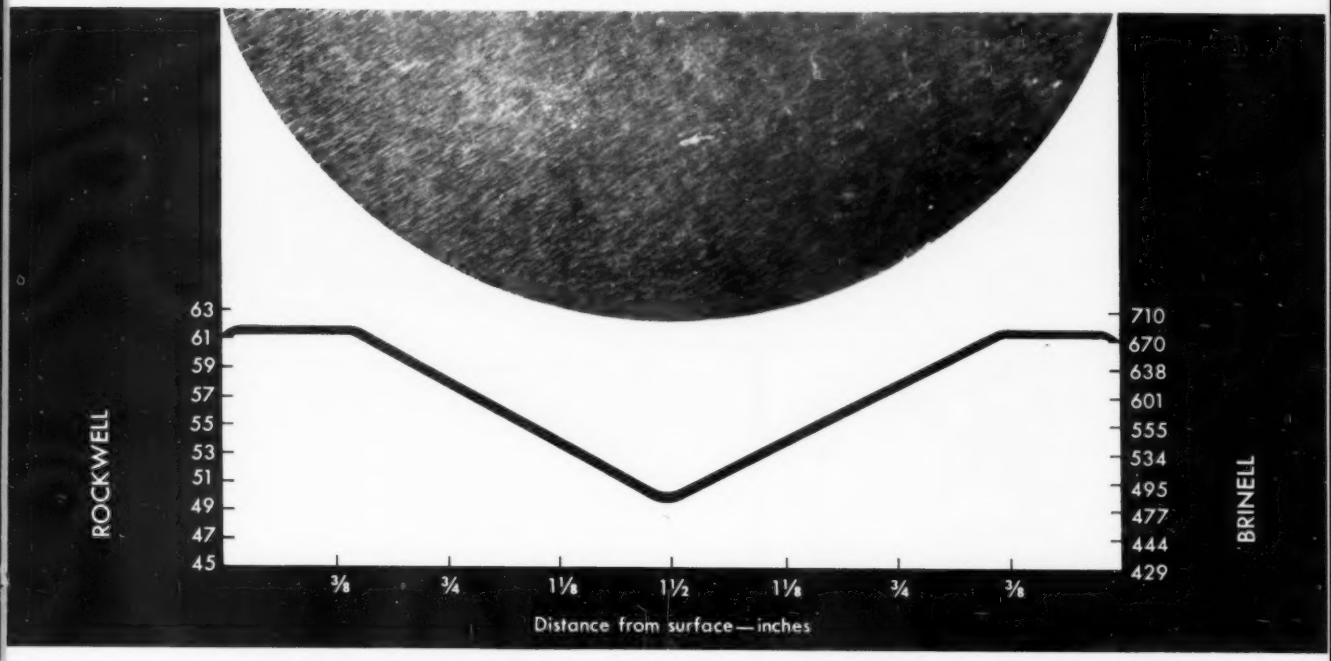
Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

ROEBLING
HERRINGBONE
WIRE ROPE

controlled metal hardness means
heat-treated cast alloy steel

NACO GRINDING BALLS

cut per-ton grinding costs



Note how new casting process and full heat treatment show controlled hardness between surface and inner core.

Spectrographic analytical control of elements in steel making processes and controlled heat treatment assure the desired metallurgical grain structure which produce the type of hardness required for maximum wearing qualities.

Performance reports on Naco solid cast alloy steel grinding balls from mills now using them have been universally favorable—both in lasting qualities and impact absorption.

Structurally, they possess a grain closely approaching tool steel—tough, hard and rugged for long lasting qualities. Laboratory tests show a remarkable uniformity in solidity, both under X-ray and specific gravity tests, with controlled hardness holding to a desired depth.

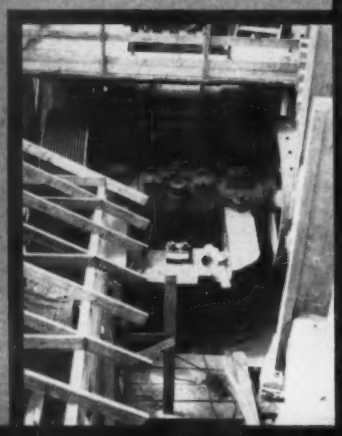
AA-5109

CAPITOL FOUNDRY DIVISION

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY

Post Office Box 750, Phoenix, Arizona

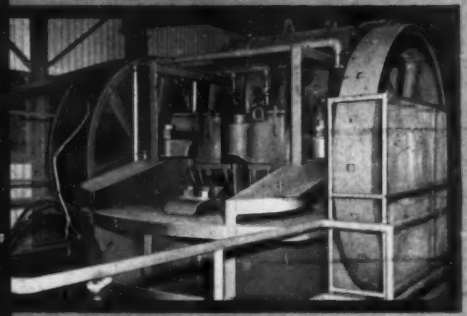
GENERAL OFFICES • CLEVELAND 6, OHIO

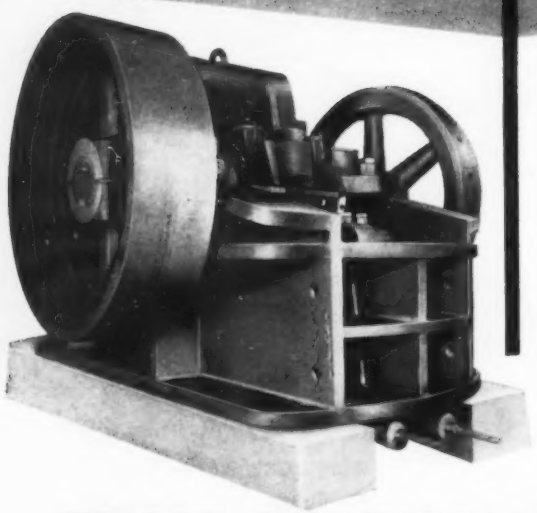


Traylor-made Type HB Jaw Crushers offer efficiency and economy

Shown above is a Traylor-made 48" x 60" Type HB Jaw Crusher in a stone crushing plant.

A Traylor-made 36" x 42" Type HB Jaw Crusher in a cement plant.





Many operators throughout the world experience daily the economy and rugged dependability of Traylor-made HB Jaw Crushers. Jaw plates are the famous curved type—the pitman shaft is made of annealed open hearth forged steel, light but of great strength. The swing jaw is made of cast steel of extra-heavy box section design to secure maximum strength. These are a few features of the Traylor HB Jaw Crusher. For additional information, write for bulletin No. 5105 today!

Traylor

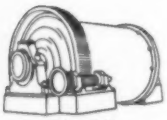
TRAYLOR ENGINEERING & MFG. CO.

1302 MILL ST., ALLENTOWN, PA.

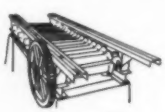
Sales Offices: New York — Chicago — San Francisco

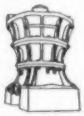
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P.Q.

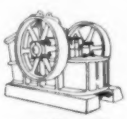
See the Traylor Display at the Chem Show, Booth No. 495, N. Y. Coliseum, Nov. 30 to Dec. 4.


BALL MILLS

ROTARY KILNS


APRON FEEDERS


PRIMARY GYRATORY CRUSHERS


JAW CRUSHERS

SECONDARY GYRATORY CRUSHERS

MINING WORLD

Rio Tinto Dow Thorium Byproduct Plant at Full Capacity

Rio Tinto Dow Limited's new thorium recovery plant is now operating at designed capacity of approximately 250 tons per year of thorium. Feed for the new plant is uranium tailing from the Quirke mill of Algom Uranium Mines Limited in the Blind River district, Ontario, Canada.

A solvent extraction process is used in the plant to produce a 15 percent thorium concentrate for further refining. A portion of this concentrate is then upgraded in the plant to produce metallurgical grade thorium oxide for the Canadian market. The remainder of the concentrate is shipped without further processing to the United States and England for refining. Processing in the United States has been on a custom basis so that Rio Tinto Dow has for sale on the United States market the following products: thorium hydroxide, anhydrous thorium fluoride, metallurgical grade thorium oxide, thorium metal, and a thorium magnesium master alloy.

Pictured here adjusting a flow meter is one of only 18 employees required to operate the plant 24 hours per day seven days a week. Automation and electronic controls from the master panel shown in background make this possible in the $1,000,000 plant.

This is the only plant using tailing from any uranium mill in the Blind River or Bancroft areas for thorium recovery, despite the fact that all tailings contain thorium. Thus, the Canadian uranium operations represent a major new source of thorium which must be taken into account in planning the long term future of atomic power. It is regrettable that the present waste disposal methods used by the mills render this thorium economically unavailable for future recovery.

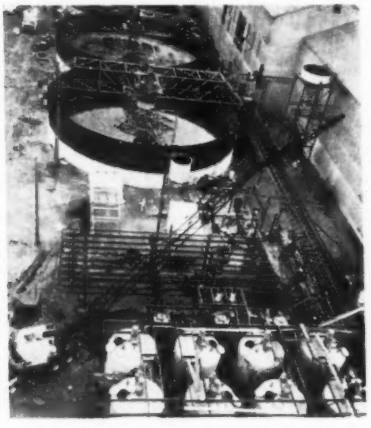
The present principle market for thorium is in magnesium alloys where the addition of 2.0 to 4.0 percent thorium improves the high temperature creep properties. Such alloys are finding increased uses as structural materials in the aircraft and rocket industries. The nuclear market at present is small, but with the increased emphasis on breeder reactors there is hope that it may use significant quantities within the next 10 to 15 years.

A more traditional market, which has been a major user of thorium, continues to be surprisingly strong. This is the use of thorium nitrate for production of gas lamp mantles.

Rio Tinto Dow was formed by Rio Tinto Mining Company of Canada Ltd. and Dow Chemicals of Canada Ltd. J. D. Head is general manager of the firm.

New Alkaline Circuit To Open . . . Uredco Will Treat High Lime Ore

Construction of a new alkaline leach circuit to replace one of two existing acid leach circuits is nearing completion at Uranium Reduction Company's mill in Moab, Utah. The new section, designed to treat 800 tons per day of the Big Indian district's high lime ores, is expected to go on stream sometime this month. The new circuit is expected to show a 50 percent cut in cost of sulphuric acid. Its major equipment (partially shown in photo at left) includes a regrind mill for use in conjunction with an existing ball mill, 12 10,000-gallon autoclaves, three 85-foot thickeners, and a product recovery section. An existing basket type, Resin-in-Pulp ion exchange section will be used in conjunction with the new alkaline equipment. Low lime ores will be acid leached and uranium recovered by RIP in the unchanged section.



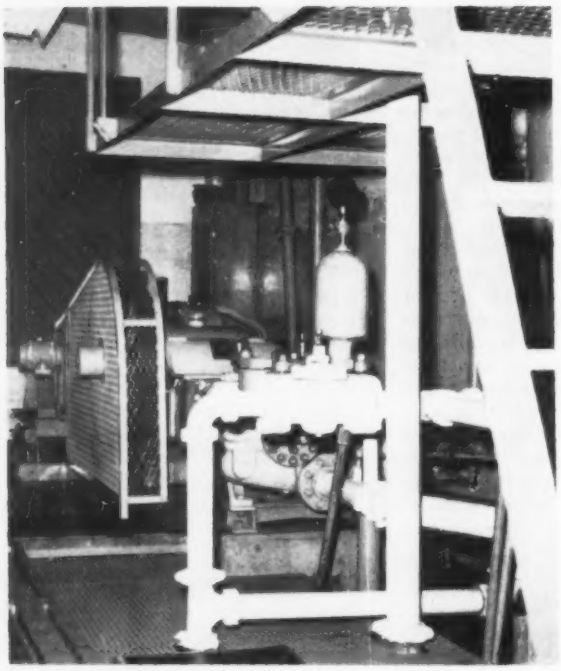
Design work for the $2,000,000 project was done by Knowles Associates. Construction was handled by Western Knapp Engineering Co.

The conversion program was contingent upon renegotiation with the AEC for sale of uranium concentrates after 1962. An extension was granted until 1966.

For the first time, the AEC recently made public statistics on uranium concentrate procurement from domestic and foreign sources for the 12 fiscal years 1948 to 1959. This action followed declassification of all data on U_3O_8 production and procurement before July 1, 1955. Statistics after that date had been declassified in 1956. The figures illustrate the rapid growth of the U.S. uranium industry . . . from domestic procurement in 1948 of 110 tons, to 15,160 tons in 1959. Ore from foreign sources totalled 1,960 tons in fiscal 1948 and 18,170 tons in 1959. Uranium receipts from domestic sources are now expected to equal or exceed foreign receipts in fiscal years 1960 and 1961.

HYDRAULIC FILL

pumped over 9,000 feet . . . distributed under high head



PISTON PUMP at surface plant has provided good service while handling a deslimed tailing composed predominantly of quartzite. It is a Gardner Denver FD-FXD model.

1. Plant designed around piston

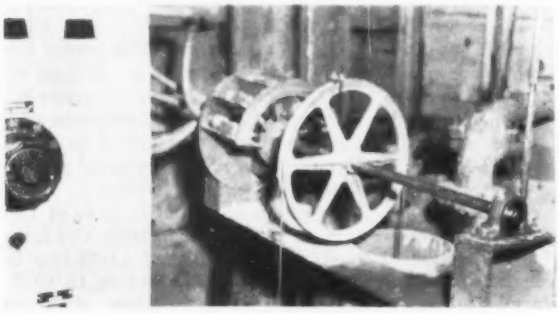
A Gardner Denver duplex piston pump, shown at the left, is the nerve center for Hecla Mining Company's new sand system which serves cut and fill stopes of the Star lead-zinc mine at Burke, Idaho.

It delivers de-slimed mill tailing at 19.7 tons-per-hour to a shaft through a 3-inch pipeline suspended in the 8,600-foot-long Star tunnel on the 2,000 level of the mine. At the shaft, the hydraulic fill is distributed above and below the 2,000 level station for further handling before it is poured in stopes. Total rise from the pump to the 2,000 level shaft station is 90 feet (50 feet from mill to tunnel and 40 feet rise on the 0.5 percent tunnel grade).

Originally the plant was designed to introduce fill to stopes below the 2,000 level at the 850-ton-per-day mine, but advantages of hydraulic fill, coupled with the initial success of the plant in servicing lower levels, resulted in the installation of a second nearly identical pump on the 1,700 level, 300 feet above the 2,000 level station. This latter pump is called upon to deliver backfill to stopes over 1,000 vertical feet above the underground pump station.

Considering the extreme high heads, the distances involved, and the use of piston pumps, the new hydraulic fill system has been a huge success. To summarize: hydraulic fill has helped increase production on lower levels where wall rock pressures are very heavy; it has reduced dilution of ore with wall rock; it is believed to have helped to minimize rock bursts; and has greatly speeded production and cut costs.

Through June 1959 nearly 50,000 tons of hydraulic fill



MICRO SWITCH makes 1700 level pump hydraulically follow the surface pump. It is float-controlled from 1700 level sump and varies speed of 1700 level pump.

2. Underground storage of

Mill tailing taken from the zinc side of the Star flotation mill is directed by gravity to a three-compartment collector box. One compartment is piped directly to the tailing race where material is discharged to waste. Another compartment pipes feed to the backfill preparation plant located at the mill. An air-operated gate on the collector box is remote-controlled from the backfill plant, and allows the operator to divert zinc tailing to waste or to the hydraulic backfill preparation plant.

Tailing can be taken to the backfill plant by gravity at the rate of 367 gallons per minute, or 31.3 tons per hour at 25 to 28 percent solids. At this point, the solids have a specific gravity of 2.75 and the slurry a specific gravity of

A Study That Includes

Wear rates of pump parts p. 34
Diagram of one of world's longest slurry lines p. 35
Detailed filling costs p. 37
A summary of new stoping methods in bad ground p. 37

POURING RATE in cut and fill stopes on lower levels is 40 to 65 tons per hour when fill is taken up raise to stope.

pumps that were never intended for abrasive service

had been placed in the Star stopes since pouring began in August 1958. Approximately 85 percent of this tonnage has been placed in stopes below the 2,000 tunnel level. The pumping plant on the 1,700 level which serves stopes above the tunnel level has been in operation only since June 1959. The cost per ton of sand pumped has averaged $1.51. This figure, however, includes deferred engineering and installation charges of over $0.20 per ton of sand pumped. These latter will soon be written off with a resulting reduction in backfill costs.

For comparative purposes these general figures apply to the operation. One ton of de-slimed tailing will fill the space occupied by two tons of ore in place. For every ton of sand pumped into the mine from the surface 0.81 tons is poured in the stopes. During June 1959, 71 percent of the available sand was poured in stopes. In all probability it will be impossible to use more than 90 percent of the available sand.

It is worth noting that use of mill tailing in stopes posed a potential drainage problem since the unclassified tailing contained large amounts of slimes (50 percent minus-325-mesh). It has been demonstrated by several investigators, however, that slimes are not really damaging to percolation rates if minus-10-micron fines can be removed. This, of course, is where cyclones have an inherent advantage for preparing hydraulic backfill. They are capable of scalping out micron size fines, yet can leave enough minus-325-mesh to provide adequate lubrication for pipelines.

Standard tests indicated a 2½ to 2¾ inch percolation rate for Star sand fill containing 22 to 24 percent minus-325-mesh fines. This is considered a fairly slow rate, but little difficulty has been experienced in adequate drainage of water or in compaction of material in stopes. In practice, the tailing is deslimed to about 18.5 percent minus-325-mesh and it will support a man within an hour following a pour.

The entire installation was carefully engineered and designed. The Hecla staff knew that piston pumps would work because transportation of hydraulic fill had been piloted using a small, 2½ by 6-inch, slush fitted, Gardner Denver air-operated piston pump and a 1-inch pipeline. This pump was available from previous grouting operations and it was operated with cyclone prepared tailing from the mill. Test filling of a drainage tunnel near the surface was carried on using the pilot plant facilities.

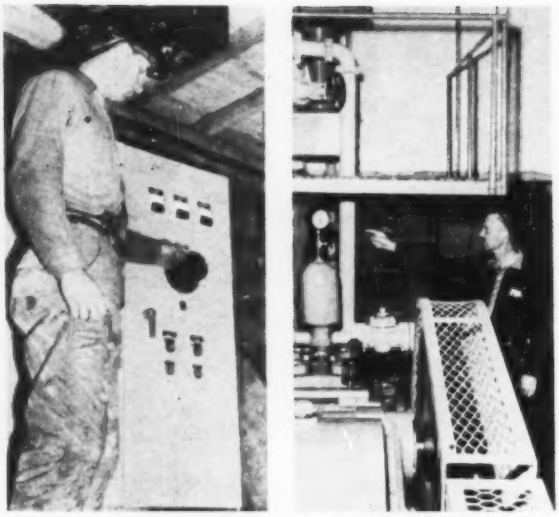
With regard to equipment selection the only choice open to the staff lay between use of centrifugal pumps or the adoption of piston pumps. Cost was the major factor that swung the decision to piston pumps. The plant and network designed to provide fill for the lower country required an expenditure of about $63,000. This included piping, cyclones, agitator, and piston pump for the mill. The drive for the piston pump was available at the mine though it required modification of two motor-generator sets. Cost estimates of the pumps and drives for a centrifugal system furnishing the same volume was greater. As an added advantage, the piston pumping circuit was adaptable to further extension.

pulp for lower levels . . . Series pumping for upper levels

1.43. When the backfill plant is operating, tailing is piped by gravity to two Krebs D-10-B cyclones in parallel. The cyclones are fed through 6-inch pipe and operate at a pressure of 11 to 12 pounds-per-square-inch. The underflow, at 50 percent solids with 32 percent minus-325-mesh, is sumped in a conical tank which maintains a constant head for the Gardner Denver piston pump.

Constant head for the piston pump is maintained by bleeding a small portion of the cyclone overflow and taking it across the top of the conical sump. Intermixing of cyclone underflow and cyclone overflow is minimized at this sump by piping the underflow into the lower portion of the sump. A valve placed between a collector box for cyclone overflow and the constant head sump allows the operator to control the rate of overflow across the top of the constant head sump. The remainder of the cyclone overflow and pulp overflowing a weir on the constant head sump is wasted.

The Gardner Denver, FD-FXD 5 by 10-inch duplex unit in the surface plant can be fitted with liners from 5 inches to 3 inches in diameter. The drive is equipped for precise speed control using a Ward-Leonard hook-up, so that variable slurry flows can be maintained. Depending on liner size the pump can operate at pressures that range from 574 to 1,500 pounds-per-square-inch. The pump is equipped with an air surge chamber, adjustable shear pin



MANUAL CONTROL of 1700 level pump speed is pointed out by Gary Rice (left); Wally Crandall, Hecla chief engineer, says pump operates at 520 psi to 1700 level.

Diagram Shows Network and Includes:

For Levels Below 2,000:

1. Surface plant located at mill which contains Krebs cyclones and a 5- by 10-inch Gardner Denver duplex piston pump.
2. 8,700 feet of pipeline entering the mine through the 2,000 level tunnel 50 feet above the surface pumping plant.
3. A cyclone installation at the 2,000 level shaft station which feeds an open end pipe line to the 4,300 level.
4. An agitator equipped holding tank on the 4,300 level which feeds stopes on 5700, 5900 and 6300 levels by gravity.

For Levels Above 2,000:

1. The same surface plant and Star tunnel pipeline; latter branches at shaft, however, to by-pass 2,000 level cyclone station.
2. An identical piston pump on the 1,700 level shaft station delivers slurry to stopes above 1,700 level.

relief valve, and a manual by-pass to test the pump or back-flush the line. Fresh water piping, with check and gate valves, is carried into each side of the pump cylinder to flush the pump in case of failure while it is full of sand.

Pump pistons 4¾ inches in diameter have given the best service so far. Replacement parts for the pump include pistons, cylinder liners, piston rods, valves, valve seats, valve springs, and packing. The piston consists of a steel core with replacable rubber sleeves. The steel core outlasts two or three sets of rubber sleeves. The piston-etched chrome liner combination has a service life up to 400 hours, and is effective until wear becomes so great that the seal is lost between the piston and cylinder wall. If the seal is lost, sand can cut deep into the piston. Chrome-surfaced piston rods have a service life of 900 to 1,000 hours. See table for indicated service life of parts and pump pressures.

The piston pump at the mill delivers a pulp that contains 47 percent solids at a rate of 119 gallons per minute into the mine. This is equivalent to 19.7 tons per hour of sand through a 3-inch line at a velocity of 5.2 feet per second. The fill prepared at the surface plant contains 32 percent minus-325-mesh particles.

The pulp is taken into the mine through an 8,700-foot-long, 3-inch pipeline of schedule 40 steel which is coupled with Victaulic fittings. In profile, this line rises 50 feet from the Star mill to a ventilation crosscut which joins the 2,000 haulage tunnel near the portal. The pipe is suspended from drill steel driven into one wall of the haulage tunnel. The pipeline between the ventilation crosscut and 2,000 level shaft station is 8,500 feet in length. Throughout this length, the pipe was carefully graded to conform to the 0.5 percent tunnel slope.

Wear has not been a problem in the line between the mill pumping plant and the 2,000 level shaft station. Breaks which have occurred in the line have been traced to vibration, which apparently causes small cracks to form near the couplings. Once a pipe begins leaking, it is only a short time until the line has to be repaired. Examination of the system between the shaft station and the mill reveals little wear, but a black deposit is forming inside the pipe and the mill pump. The Hecla staff feels that the lubricating action of the relatively high percentage of fines in the pulp is the chief contributing factor to the lack of wear. The black deposit is thought to be caused by sodium sulphide which is used at the mill. This problem is under study.

Circuit to Lower Levels

At the 2,000 level shaft station, the backfill is discharged to a constant head sump. The sump feeds a 3 by 3-inch A-S-H Hydroseal pump which forces pulp to a Krebs D-10-B cyclone. A portion of the cyclone overflow can be diverted to the sump to maintain a constant head for the feed pump in a manner similar to the setup at the surface

Parts Life of Mill Pump Has Exceeded Expectations

Part	*Hours of Service*
Pistons	
Pistons with replacable rubber sleeves	150 to 402*
Solid rubber and steel pistons	75 to 150
Piston rods	
Non-chromed steel rods	150 to 250
Chrome surfaced rods	900 to 1,000
Cylinder Liners	
Polished chrome liners	250 to 360
Hardened steel liners	170 to 220
Etched chrome liners	350 to 400

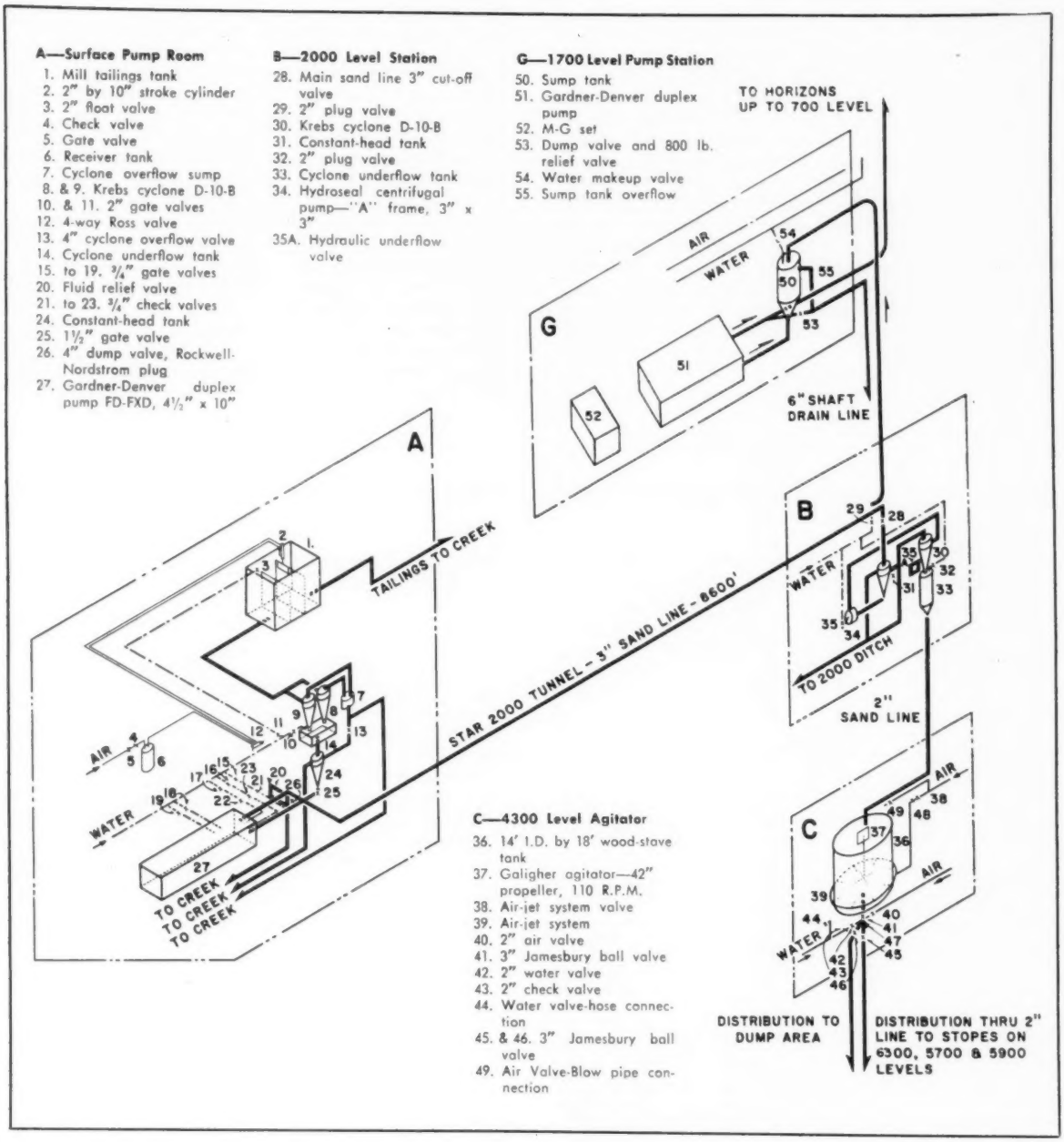
*Made up of 152 hours while operating at 530 psi and 250 hours at 300 psi.

Pump Pressures Required for Distribution of Hydraulic Fill

Pump Duty	*Strokes/Min.*	*% Solids*	*PSI*
Surface pump			
to 2,000 level sump	45	48	310
to 1,700 level pump station	45	48	530
1,700 level pump			
to 1,200 level	45	48	390-430
to 1,000 level	45	48	450-500
to 850 level	45	48	550-590
to 700 level	45	48	650-670

through the 2-inch line at 16 to 17 tons per hour. Opera-

on the impeller shaft so that it flows slowly down the shaft


A—Surface Pump Room
1. Mill tailings tank
2. 2" by 10" stroke cylinder
3. 2" float valve
4. Check valve
5. Gate valve
6. Receiver tank
7. Cyclone overflow sump
8. & 9. Krebs cyclone D-10-B
10. & 11. 2" gate valves
12. 4-way Ross valve
13. 4" cyclone overflow valve
14. Cyclone underflow tank
15. to 19. ¾" gate valves
20. Fluid relief valve
21. to 23. ¾" check valves
24. Constant-head tank
25. 1½" gate valve
26. 4" dump valve, Rockwell-Nordstrom plug
27. Gardner-Denver duplex pump FD-FXD, 4½" x 10"
B—2000 Level Station
28. Main sand line 3" cut-off valve
29. 2" plug valve
30. Krebs cyclone D-10-B
31. Constant-head tank
32. 2" plug valve
33. Cyclone underflow tank
34. Hydroseal centrifugal pump—"A" frame, 3" x 3"
35A. Hydraulic underflow valve
G—1700 Level Pump Station
50. Sump tank
51. Gardner-Denver duplex pump
52. M-G set
53. Dump valve and 800 lb. relief valve
54. Water makeup valve
55. Sump tank overflow
TO HORIZONS UP TO 700 LEVEL
AIR
WATER
6" SHAFT DRAIN LINE
TAILINGS TO CREEK
STAR 2000 TUNNEL - 3" SAND LINE - 8600'
TO 2000 DITCH
2" SAND LINE
C—4300 Level Agitator
36. 14' I.D. by 18' wood-stave tank
37. Galigher agitator—42" propeller, 110 R.P.M.
38. Air-jet system valve
39. Air-jet system
40. 2" air valve
41. 3" Jamesbury ball valve
42. 2" water valve
43. 2" check valve
44. Water valve-hose connection
45. & 46. 3" Jamesbury ball valve
49. Air Valve-Blow pipe connection
TO CREEK
TO CREEK
TO CREEK
DISTRIBUTION TO DUMP AREA
DISTRIBUTION THRU 2" LINE TO STOPES ON 6300, 5700 & 5900 LEVELS

plant. The bulk of the cyclone overflow, with the exception of the amount required to supply the sump, is discharged to a drainage ditch in the Star tunnel. The solids have not shown a tendency to settle in the ditch.

The cyclone underflow is discharged at 70 percent solids to a small tank that feeds a 2-inch line in the shaft. The shaft line is composed of standard weight steel pipe joined with Victaulic couplings. At the 4,000 level, this line sweeps across the station for a distance of approximately 125 feet and enters a 65° raise that connects with the 4,300 level. At the bottom of the raise, the 2-inch line travels horizontally 125 feet to a 14- by 18-foot Galligher agitator. The pipeline from the 2,000 station to the agitator on the 4,300 level is open-ended, and since there is insufficient slurry to fill the line, the pulp between these two points travels in surges. Pipelines smaller than 2-inch were considered too small because of the danger of plugging.

The pipe in the shaft was aligned for true vertical position by hanging plumb wires during installation. The 2,000 to 4,300 portion of the circuit has undergone considerable wear, particularly at the point marking the end of the free fall of the pulp in the shaft line, and at bends at stations. As fast as the steel pipe wore out, it was replaced with 2-inch-internal-diameter pipe containing ¼-inch rubber lining. The shaft line is now composed of rubber-lined pipe from the 2,000 level to beyond the sweep at the 4,000 level. Throughout the mine, a minimum 4-foot radius is employed for the sweeps (most are more than 4 feet).

The dense pulp prepared by the 2,000 level cyclone contains 18.5 percent minus-325-mesh, and it travels

through the 2-inch line at 16 to 17 tons per hour. Operation of the sump, pump, and cyclone on the 2,000 level is automatic except for start up.

The 14-foot-diameter wood stave agitator on the 4,300 level has a capacity of 100 dry tons of sand. The tank is equipped with a 42-inch-diameter, rubber-lined impeller placed 4 feet above the bottom of the tank. The impeller is driven at 110 revolutions-per-minute by a 30-horsepower reversible motor, a feature designed to help free a stuck impeller from sand. The agitator is also equipped with eight peripheral air jets mounted 18 inches above the bottom of the tank to help maintain solids in suspension. Trouble was experienced with the impeller shaft because it tended to whip in the dense mixture. A rubber-lined steel sleeve bearing was placed at the bottom of the impeller shaft to correct this situation. Life of the rubber lining in the bearing is 4½ months.

It takes about 5 hours to fill the tank to capacity. In operation it is never emptied completely. Water is turned on the impeller shaft so that it flows slowly down the shaft when the bottom bearing is not submerged.

The bottom of the tank is fitted with a 3-inch diameter center discharge opening containing high pressure air and water purges. Immediately below the tank, the discharge line splits to two 2-inch pipelines. One line leads to a dump area located in an old drift on the 4,700 level. The second line is carried down to stopes worked from the 5,700, 5,900 and 6,300 levels of the mine. The stoping areas on these levels are located 800 to 1,200 feet from the shaft.

Valving below the 4,300 holding tank consists of three Jamesbury 3-inch ball valves. One is located on the center discharge of the agitator and one each is placed on the two branch lines. Gate valves cannot be used at these points because of the severe abrasive nature of the fill. The slurry is delivered to the lower levels at a rate of 121 to 197 gallons per minute which is equivalent to 40 to 65 tons of dry sands per hour. The mixture contains 70 percent solids. The rate of delivery of sand to the stopes de-

3. Hydraulic fill will permit blind stoping in bad ground on lower

All production from the Star mine is brought to the surface through the 8,600-foot long adit on the 2,000 level of the mine. The adit connects with a vertical shaft that extends down to the 4,000 level. An offset winze opens the mine from the 4,000 level to the 6,300 level. Above the main haulage adit, the mine has been developed to the 700 level. Throughout the mine, levels are spaced at 200-foot vertical intervals.

Development of the mine started in the middle horizons of the lead-zinc orebody which dips at nearly vertical and averages eight feet in width. (Minimum and maximum limits of vein width are about four and 18 feet, respectively). This past development left areas above the 2,900 and below the 5,500 levels to be mined now and in the future.

Most previous mining effort at the Star had revolved around timbered cut and fill methods. Few of the stopes could be worked without timber. The fill was obtained as waste rock from development headings on the lower levels. A quarry located on the surface furnished gob for the upper level stopes. Rock from the quarry was bulldozed into a raise where it was collected underground and distributed to working places by trains. In either case the rock fill had to be handled vertically and horizontally several times before it ultimately was placed in stopes and spread by slushers.

STOPE PREPARATION for a pour consists of spiking quarter round slabs to stope caps, which are on 5-foot centers. Burlap is stapled to quarter round end bulkhead.

While rock fill provided satisfactory results, the method at best was expensive and time consuming. As development went deeper, wall rock pressures became very heavy, making it impossible to hold raises open for gravity introduction of the gob into the stopes. Raising in the lower levels become a tortuous job and several times rock bursts occurred while raises were being driven. Squeeze often developed in stopes and raises, in fact, it was common practice to put a foot of blocking outside raise caps to allow for the effects of squeezing. In other situations, the ground appeared almost slabby and would simply fall out around a set. Caves sometimes developed from raises in this manner and it became necessary to drive around the cave to save the raise. All of these ground conditions resulted in frequent interruptions to production from stopes.

Since most of the future reserves occurred at the lower mine elevations, it was desired to gather at least 50 percent of the mine output from the lower levels. In 1957 these levels had only been called upon to furnish some 20 to 25 percent of the total output. The only way that production from lower stopes could be expedited was through the installation of hydraulic backfill. The production staff played a dominant role in recommending installation of the hydraulic fill plant.

The greatest single advantage in the change in filling procedure is that blind stoping can now be carried out on the lower levels. The raises from level to level are eliminated because hydraulic fill can now be brought in on the working level below the stope and forced up a manway for pouring. There is now no need for a raise in stope blocks between levels until the stope is finished. Under this blind stoping method, sand on the 5900 and future levels to be developed below it will have to be forced up manways a maximum distance of 200 feet. Pressure for this is provided from the holding tank on the 4,300 level. Since the new plant was installed, stopes have been successfully filled 160 feet above the working level. Where little or no vertical head is involved above a working level, fill can be poured in the stopes at a rate of 60 to 65 tons per hour. Blind stoping methods are used on the 5,900

pends on the height of the stope floor above the drift.

Circuit to Upper Levels

The circuit that provided hydraulic fill for the lower levels operated successfully for a period of nine months before the second pumping station was installed on the 1,700 level to provide fill for stopes in the upper portion of the mine. This pump station is located adjacent to the shaft and is almost identical with the mill pumping station. No cyclones are installed at the 1,700 level pump station.

The installation consists of a 5 by 10-inch Gardner Denver duplex piston pump, a small sump serving the pump, and a Ward Leonard hook-up for the DC drive. The pump sump is fed through a 3-inch steel pipeline which branches from the main line in the Star tunnel at the shaft. This line by-passes the 2,000 level cyclone. From the 1,700 level pump, the pulp is taken up the shaft in a 3-inch line and distributed to working levels. The upper shaft line has been extended to the 700 level and stopes are filled by taking the pulp up or down raises to prepared work areas.

The 1,700 pump is made to hydraulically follow the mill pump by employing a series of micro switches coupled to a float at the 1,700 pump sump. There are seven micro switch positions (three on each side of the neutral position). The float automatically adjusts the position of the switch which either speeds up or slows down the strokes-per-minute on the piston pump through rheostat control to the Ward Leonard set.

For upper levels a mine car was equipped with a cyclone surge tank, a cyclone, and a launder for cyclone underflow. This portable unit was coupled to 2-inch pipe in raises above stopes to be filled. Connection for this portable mounting to the sand line was made by means of flexible hose. The equipment was tried and, though it worked satisfactorily, it was later abandoned. It was found to be simpler and more convenient to control classification at the surface plant, and adjust the density of the fill for upper stopes at the mill pump.

levels of the mine where over half of reserves remain

level and all future mining at depth will utilize this method. Filling on the 5,900 stopes takes place at 40 to 65 tons per hour depending on the distance above the working level.

On the 5,900 level, 100-foot stope blocks are developed by driving a drift in ore and a parallel haulageway in either the foot or hanging wall. Haulage crosscuts hole the haulageway and ore drift every 150 to 200 feet. Future stopes below the 5,900 level will utilize only the drift in the wall and will dispense with the ore drift. Two-compartment cribbed raises are carried up with the stope from the service crosscut. One compartment serves as a manway and the other as a timber slide. Cribbed ore chutes are placed up on either side of the access raise; each serves a 100-foot block. Top edges of the timber cribbing in the ore chutes are lined with ¼- by 2-inch angle iron.

The timbered cut and fill stopes are worked in 10-foot horizontal slices by drilling with airleg machines and breasting the ore onto 3-inch flooring. Broken ore is scraped to an ore chute which is covered with a grizzly. Most of the stopes are contracted and each contract crew readies the stope for a pour.

Stopes are prepared for filling by nailing quarter-round timber slabs, spaced 3 inches apart, to caps at the end of the stope, spaced at 5-foot vertical centers. 7½-ounce burlap is stapled to this bulkhead. Decant pipes and mousetraps in the raises are normally not required in order to drain the stope. Occasionally such devices may be necessary where ground water seeps into the stope from the walls.

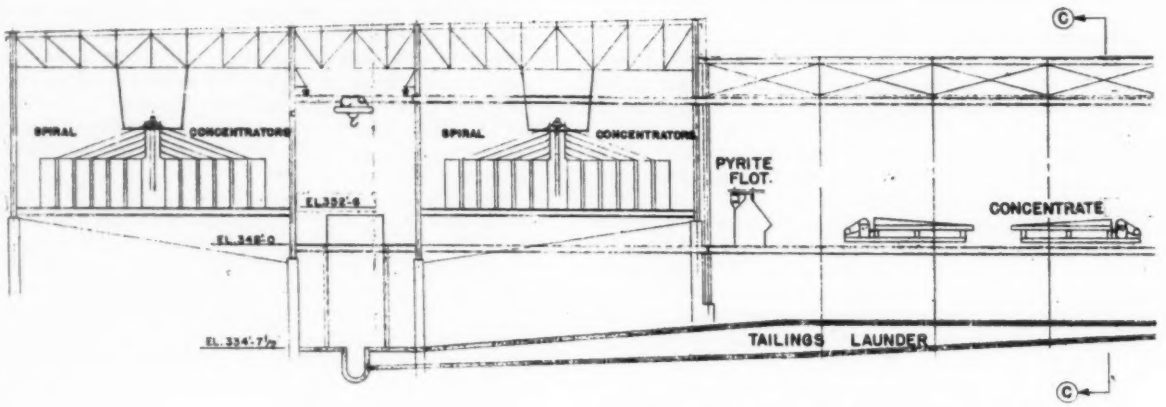
Ventilation is carried into the stopes by forcing air up one raise, through the stope, and down the next raise. It is interesting to note that use of hydraulic fill and blind stoping has resulted in improved air circulation through stopes. This is probably accounted for by the fact that the sand provides a better seal than did the rock fill formerly used.

Hydraulic fill has produced many advantages at the Star mine. Most of them are the obvious inherent advantages of the system, such as greater speed and efficiency. For instance, an excavation in a stope can be filled in two days' time where it might have taken two weeks with rock fill. Peculiar to the Star mine is the fact that hydraulic filling will probably permit more untimbered stoping to be carried on. END

Cost of Hydraulic Fill

Account charged	Cost per ton of sand pumped*
Mill Cost	
Pump repair	
Labor	$0.016
Supplies	0.087
Pumping	
Labor	0.181
Supplies	0.022
Total mill cost	0.306
Underground Distribution Below 2,000 Level	
4,300 level tank operation	
Labor	0.198
Supplies	0.035
Pouring	
Labor	0.393
Burlap & staples	0.055
Pipe & fittings	0.198
Miscellaneous	0.119
Total pouring cost below 2,000 level	0.765
Total cost below 2,000 level	0.998
Underground Distribution Above 2,000 Level	
1,700 Level Pump repair	
Labor	0.011
Supplies	0.102
1,700 Level pumping	
Labor	0.187
Supplies	0.013
Total 1,700 level cost	0.313
Pouring	
Labor	0.314
Burlap & staples	0.084
Pipe fittings	0.150
Miscellaneous	0.076
Total pouring cost	0.624
Total cost above 2,000 level	0.937
Engineering Dept. Cost	0.044
Deferred Installation Cost	0.176
Cost per ton pumped above 2,000 level	$1.463
Cost per ton pumped below 2,000 level	1.524

*Based on 46,439.2 tons placed below 2,000 level and 3,548 tons poured above 2,000 level.



A five part study of mill design and methods at . . .

NEW PLANT recovers tungsten, tin,

By Snell G. Burk

Climax Molybdenum Company's new byproduct beneficiation plant has been in operation since April 1958 treating, for the first time, all the molybdenum flotation tailing to recover tungsten, tin, and pyrite. Its successful operation is the culmination of efforts of many people on the Climax staff over a long period of years.

This type of plant should be of interest to others in the mining industry, for undoubtedly valuable minerals are being discarded that might well be recovered by extending processes in some existing mill operations.

While tungsten was known to exist in Climax ores, its economic recovery was not found feasible until 1946 with the use of Humphreys spirals in test work. Favorable laboratory work indicated a pilot plant which was built in 1947.

Ore occurs at Climax in altered pre-Cambrian granite, schist, and porphyry. Mineralization is fracture filling of quartz veinlets. The primary economic mineral is molybdenite; secondary minerals include tungsten as huebnerite, tin as cassiterite, and pyrite. Typical assays of ore are: molybdenite (MoS_2), 0.4 percent; tungsten (WO_3), 0.03 percent; tin (Sn), trace; and pyrite (FeS_2), 1.25 percent.

Recovery of the principal mineral, molybdenite, is effected by grinding, followed by flotation. Tailing from these operations is feed for the byproducts plant.

Reviews of flowsheets for these original plants show feed of primary grinding tailing to submerged classifiers and wet cyclones; classifiers' sands to spirals; cyclone underflow to spirals; spiral concentrates to flotation for pyrite removal; tabling of pyrite flotation tailing; flotation of table concentrates to remove monazite; and final upgrading of concentrates by magnetic separation. Tin, also, was recovered from separator rejects. One of the most outstanding results of operating these original plants was that the performance was almost exactly as predicted by original test work in Climax's metallurgical laboratory at Golden and the pilot plant at Climax.

A production plant of 7,000 tons was placed in operation in 1948 and in 1952 increased to a total capacity of 20,000 dry tons per day.

The later addition of 6,000 tons per day capacity in the molybdenum primary grinding circuits began to overload the byproducts plant. A survey was started in 1955 to evaluate possible future expansion of byproducts facilities. The efforts of engineering forces making this survey were interrupted to design and build two more 4,000-ton-per-day primary grinding plants.

Completion of the survey of existing byproducts facilities early in 1957 showed that they were 14,000 tons under capacity. The plant was more of a pilot plant than a production facility; this was all to the good. Overloaded conditions pointed to many useful ideas for a new plant.

The survey disclosed the following: Machinery was set on too many different floor levels. Operators could give attention to only small areas of the plant at one time. Maintenance and cleanup was very difficult because of lack of space or poor location of equipment. A great part of the pulp lines and launders were worn out. The report also showed that most of the major equipment was in good condition and basic metallurgy could not be greatly improved although some modification was indicated.

Several proposals for a new byproducts plant were presented to the Climax management. Approval was received for a complete new plant to be built adjacent to the then-existing plant. Location was predicated on the elevation and configuration of tailing discharge lines. Approval was contingent on the provision to salvage some existing major equipment for reuse.

The logistics of keeping a byproducts plant in operation while relocating used equipment during the construction period was possible in that the new plant included 384 new spirals with related new equipment but did not include classification. This enabled operators to pump classified products from the old plant to a new spiral section while used equipment was being transferred.

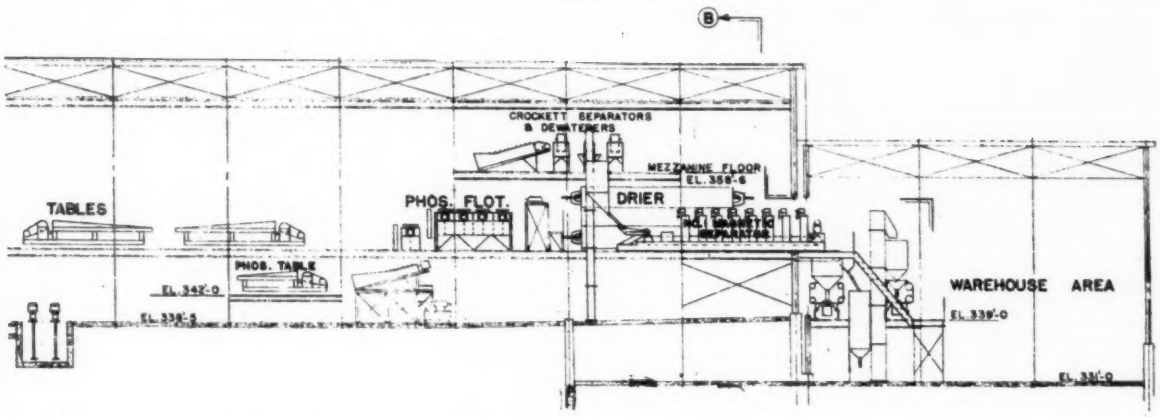
Construction actually started in June 1957. The plant was designed in detail by engineering forces at Climax.

Mr. Burk is mine and mill design engineer for the Climax Molybdenum Company, Climax, Colorado.

truck and railroad sidings. Space for testing and expansion is provided in

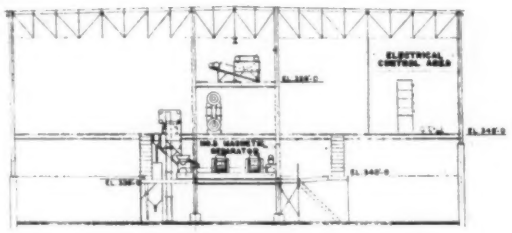
crete launders to receive the spiral

ence in old plants. Concrete launders

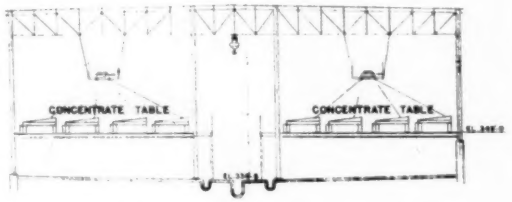


. . . Climax's 32,000 ton per day byproduct mill

and pyrite from moly flotation tailing



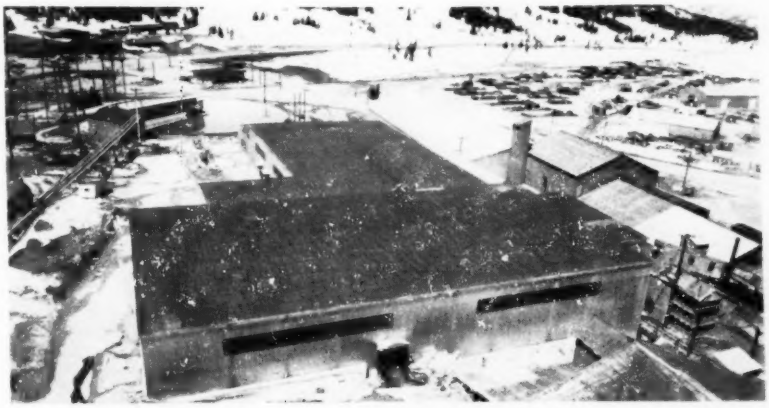
SECTION B-B shows magnetic separator area



SECTION C-C shows tabling area of plant

1. Design is functional, cuts labor to three men per shift

The structure housing the new plant is an L-shaped, flat-roof mill building of steel and concrete, centrally located in the milling plant industrial area. The east "L" is 90 by 185 feet and houses the spiral feed pumps and spiraling sections. A two-level bay through the center of this building forms a gallery for major pipe lines and launders, middling and concentrate pumps, and control equipment. The west "L" is 90 by 212 feet and houses the flotation, concentrating table, phosphorus treatment, drying, and magnetic separator sections. This also is two-level, with open steel decking on the intermediate floor. An electrical control center and warehouse for plant products are also included in this area. Plant service openings are provided to the adjacent



L-SHAPED STRUCTURE was the result of a three year survey of design and methods used in old plant. The new facility reduced the working levels to two, contains centralized pulp lines and pump stations, and employs concrete launderers.

truck and railroad sidings. Space for testing and expansion is provided in some areas of the plant. A maintenance shop is located at the intersection of the two "L's" of the structure.

Roof trusses are designed to support a 60-pound live load, plus hanging galleries within the building. The building covering is a sandwich of zinc-coated corrugated steel and insulation.

Concrete structures become major construction items in the new plant. It was necessary to slope launders nearly 2 inches per foot to collect heavy mineral concentrates at centralized pumping stations; this increased elevations of concentrate galleries and thereby the concrete structures. Concrete launders to receive the spiral discharge were also provided. Spread footings and high cantilever walls were necessary because of plant location and design for possible future expansion. Also, special consideration had to be given to soil-bearing characteristics of glacial till under certain moisture conditions.

The plant was laid out for operation on two levels, but principally on one. Electrical control consoles, all on one level, are contiguous to equipment in each operating area. Ample space for operation and maintenance is provided. A service crane and hoist is available over all major equipment.

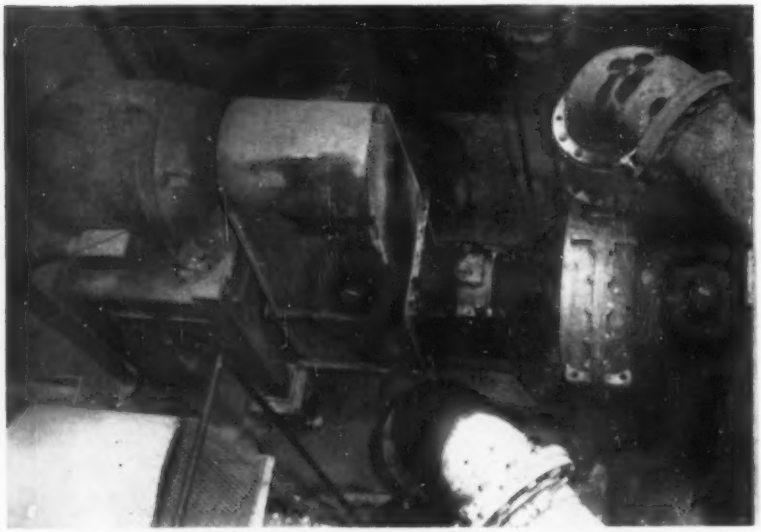
In the new plant, major design considerations were based on experience in old plants. Concrete launders were designed to contain the great volumes of highly abrasive pulp that flow through the plant and which so quickly wear out conventional piping and launders. Slopes of floors and galleries are graded to main tailing launders to provide easy cleanup. All high velocity pulp lines and pumps are rubber lined. Duplicate pumps are provided for standby service throughout the plant.

So effective has plant design been that only three men per shift are necessary to operate it—an operator, a helper, and one spiral tender (cleans wood chips etc.). A concentrate packer works day shift only. Two men are on duty during the day for maintenance.

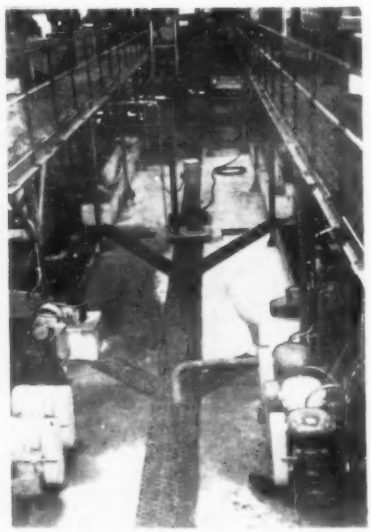
2. Pump schedule for the 32,000 tpd by-product plant

Number Units	Size Inches	Make and Model	Feed	Total Head Feet	Volume Gallons Per Minute	Specific Gravity Pulp	Percent Solids	Horsepower[1]	Revolution Per Minute
2	12	D-41-5 Hydroseal	Mill tailings —28-mesh	42	4,700	1.34	40	105	500
2	12	D-6-5 Hydroseal	Mill tailings	58	6,000	1.34	40	160	560
4	6x6	Deco SRL	Spiral middling	40	650	1.18	20	12	800
4	5x5	Deco SRL	Spiral concentrate	60	200	1.20	20	7.5	960
1	3x3	Deco SRL-C in series with	Pyrite					7.5 to	
1	3x3	A.C. SRL-C	Pyrite	80	50[2]	1.40	35[2]	11[2]	
4	3x3	Deco SRL	Table feed	40	150[2]	1.18	20[2]	3.5	1,080
2	2x2	A.C. SRL	Table middling	35	25[2]	1.05	5[2]	1.5	1,050
2	2x2	A.C. SRL	Table concentrate	40	30[2]	1.05	5[2]	1.7	1,080
2	2x2	Deco SRL	Table concentrate	40	30[2]	1.05	5[2]	1.7	1,080
2	2	Amsco-Nagle-Vertical	Clean up	50	100 intermittent			5.0	1,200
1	1	Wilfley "K"	WO_3 concentrate	30	30	1.05	5	1.2	1,720
2	1	Wilfley "C"	WO_3 concentrate	30	30	1.05	5	1.2	1,720
2	¾	Worthington-chemical	Starch reagent	25	25	1.02	—	0.75	1,720

1. Actual horsepower. 2. Varies.



HYDROSEAL SLURRY PUMPS are used to elevate molybdenite flotation tailing to distributors at top of spiral sections. These 12-inch rubber lined pumps are D-6-5 and D-41-5 types feeding the South and North spirals respectively.



PUMPS are set on lower floor to insure gravity feed and easy clean up. Spare pumps are provided for every circuit.

zite is fed to a small deck No. 14 ity to a 14-inch Wemco spiral classifier abrading of liners and balls in previ-

3. Spirals make a bulk concentrate for further treatment

The new plant treats over 32,000 dry tons per day of combined tailings from primary grinding plants which are fed to the Humphrey spirals. (34,000 tons primary grinding feed minus 5 percent rougher flotation froth to the molybdenum circuit regrind cleaner plant.)

Screen Analysis Climax Byproduct Plant Feed[1]

Mesh	Direct	Cumulative
+ 35	2.6	2.6
+ 48	9.6	12.2
+ 65	14.8	27.0
+100	11.8	38.8
+150	8.6	47.4
+200	4.6	52.0
−200	48.0	100.0

1. This is molybdenum mill tailing containing 40 percent solids.

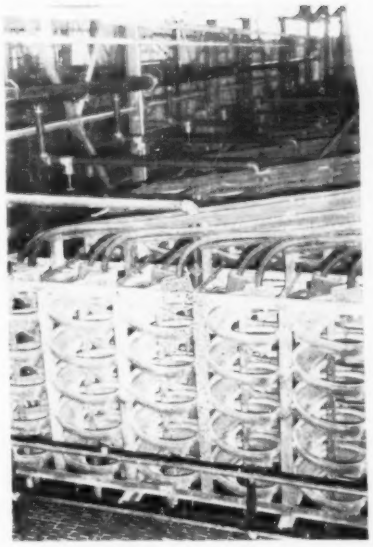
The spiraling is divided into two parallel sections, 384 spirals in the "South" section and 320 spirals in the "North" section. Each section is fed from separate sumps by 12-inch, slurry-type, Hydroseal, rubber-lined pumps; 200- and 150-horsepower are applied to the "South" and "North" sections, respectively. Initial velocity through a hydraulically balanced distribution system is 17 feet per second; the pulp arrives at the spiral distributors at less than 5 feet per second. This piping system is rubber-lined throughout.

In the new plant, about 48 dry tons are fed to each Humphreys spiral in 24 hours. Water consumption is 5.0 gallons per minute per spiral. The spirals used at Climax are five turn, and are made of white iron castings. Concentrate is taken off at three ports of the 15 available. A middling product is taken off at a bottom port and returned to the spiral feed sumps by 6 by 6 SRL pumps. This amounts to about 7 percent of the initial feed.

The middling, when combined with initial feed, makes a total feed of 11,000 gallons per minute of pulp to the spirals.

The spiral tailing discharges directly into a concrete launder system which collects and conveys all tailing to the main disposal system.

Spiral concentrate flows in concrete and rubber-lined steel launders to sumps in the North and South sections. The collected concentrate is pumped by 5 by 5 SRL rubber-lined pumps to 10-inch Krebs 20° wet cyclones for dewatering. Cyclone underflow is approximately 30 percent solids containing 0.6 percent WO_3, 30 percent pyrite, and miscellaneous minerals which flow by gravity to the pyrite flotation circuit. Cyclone overflow is collected in a manifold to be used as makeup water for flotation and tabling circuits.



SPIRALS treat an unclassified tailing minus 35 mesh in size. Units are divided into two parallel circuits.

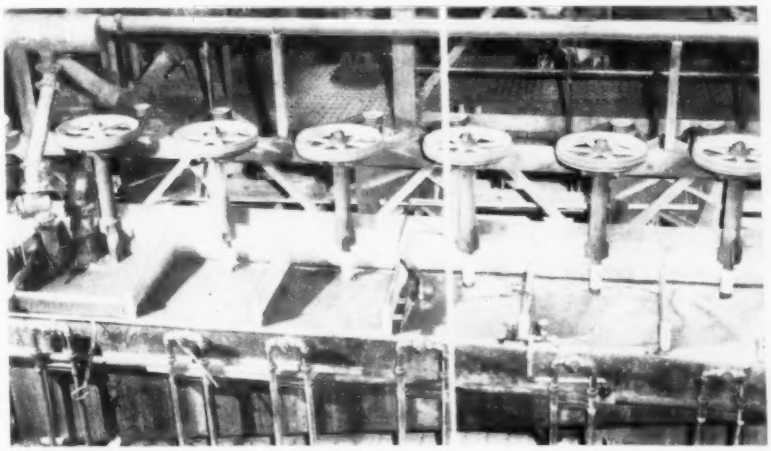
4. Pyrite floated . . . tailing is tabled . . . monazite rejected

Pyrite flotation is effected in an 8-cell Climax-Weinig rubber-lined machine using sulphuric acid to make a pH of 5.0; Z-3 ethyl xanthate is used as a collector. Pyrite concentrate, 50 percent sulphur, is stockpiled for shipment to acid manufacturers. Non-float fraction (tailing), flows to sumps for distribution to a concentrating table system with 3 by 3 SRL pumps.

The tabling circuit is divided into two sections of two stages: eight rougher and two middling tables in each section. All 20, No. 6 Deister tables are full size, with single slime decks. Approximately 22 dry tons per day are fed to each table. Table concentrate is pumped by 2 by 2 SRL pumps to the phosphorous removal circuit and is on the order of 6.0 tons per day at 8.0 percent solids assaying 40.0 percent WO_3.

Table concentrate includes monazite sands containing phosphorous. If this was dried and fed directly to the magnetic separator circuits, its weak magnetic characteristics would cause phosphorous to report in the final tungsten concentrate.

Monazite is effectively removed by flotation. After dewatering in a 12-inch Wemco classifier to 85 percent solids, the table concentrate is fed directly to a flotation circuit using an 8-cell Stearns Roger 16-inch machine; hot water is added to heat the pulp to 100° F. Sulphuric acid is added to make a pH of 1.2; the amine, Armac "C," is added as a collector, starch is added as a selective depressant of the huebnerite. Froth concentrate on the order of 2.5 tons per day of mona-

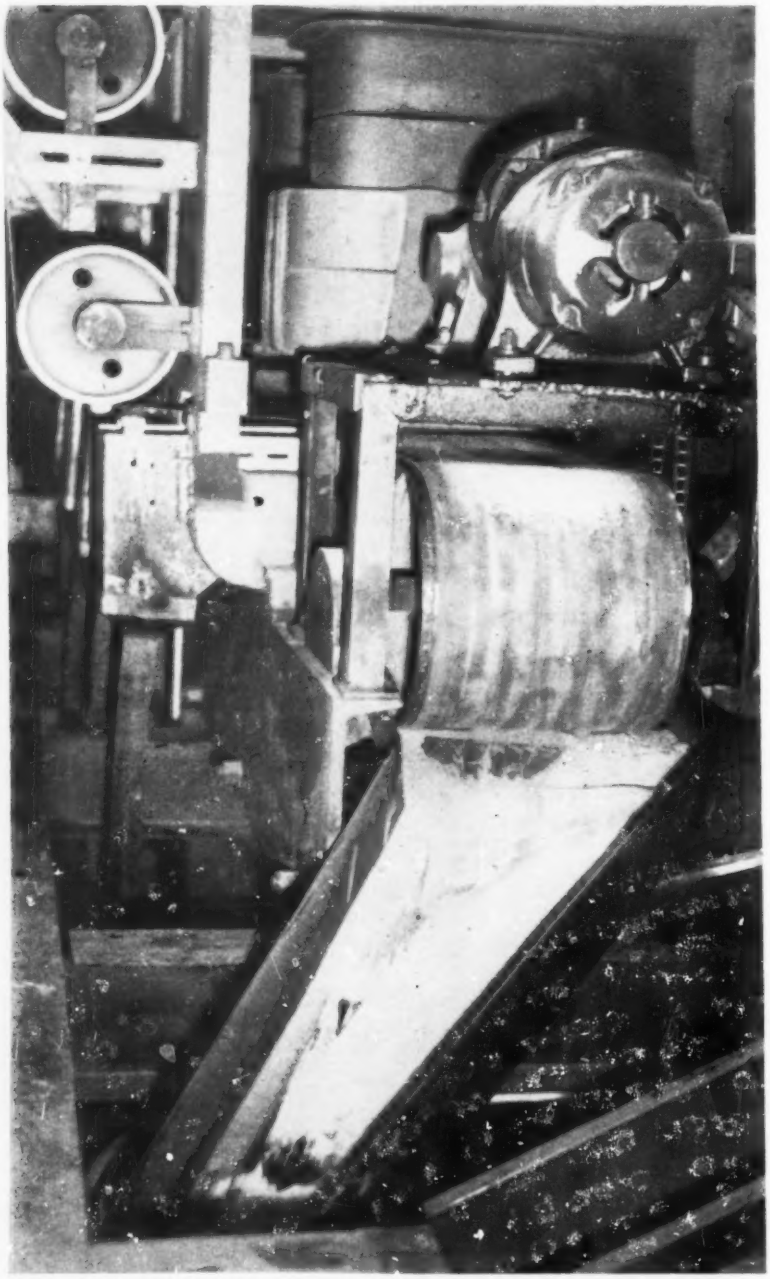


PYRITE FLOTATION is carried out in two 8-cell 36-inch Climax Weining flotation machines after spirals upgrade feed to 30 percent FeS_2. The concentrate is stored in winter and shipped during the summer to a sulphuric acid plant.

zite is fed to a small deck No. 14 Deister table which serves as a monitor to check tungsten that may report in the froth. Table concentrate of "D" grade tungsten, about 200 pounds per day, is collected and dried; table tailing is discarded. The monazite flotation tailing or nonfloat flows by gravity to a 14-inch Wemco spiral classifier for dewatering with attendant removal of acid. Sands from the classifier are pumped by 1-inch Wilfley sand pumps to a wet magnetic separator.

The low intensity wet magnetic separator has a submerged belt to remove metallic iron derived from abrading of liners and balls in previous crushing and grinding operations. About 500 pounds of iron are discarded daily from this separator. Separator discharge is dewatered in a 14-inch Wemco spiral classifier to approximately 85 percent solids in preparation for drying.

5. Cross belts recover two grades of tungsten concentrate



MAGNETIC SEPARATORS are Dings high intensity cross belt type. Three separators make a high and low grade tungsten concentrate, and magnetic rejects containing 8.0 percent tin which is fed to the tin recovery circuit.

Drying of concentrates is effected in an Allis-Chalmers two-tube horizontal ribbon flight dryer with steam jackets and shafts. Steam pressure is varied; ordinarily carried at about 80 pounds (gauge) or 324° F. Feed and product moisture contents are about 15 and 0.5 percent, respectively. Dryer products discharge to a 40-mesh, 48-inch-diameter, Sweco vibrating screen; oversize is discarded and undersize is conveyed by a bucket elevator to a surge bin for crossbelt separator feed.

Magnetic separation of plant products is in three stages. All separators are high intensity crossbelt type, which also use perma-plate magnets and/or in some cases one crossbelt pole for residual iron removal. Magnetic flux is controlled by air gap spacing. Intensity is increased by decreasing the gap.

The first stage separator is a Dings, 8-pole, 18-inch-wide machine with a perma-plate magnet. The second stage uses a Dings, 4-pole, 12-inch wide machine. The third stage is a Dings, 4-pole, 12-inch wide separator equipped with an auxiliary pole and crossbelt for iron removal.

Two grades of product are made from this operation; a 72 percent WO_3 product called "A" grade and a 40 to 50 percent product called "D" grade which is contaminated with minerals of the rutile-ilmenite group.

Concentrate from the first stage is upgraded to "A" grade on the third stage. Rejects from the first stage are upgraded to "D" grade on the second stage. Rejects from the second and third stages go to the tin circuit. Approximately 0.140 of a pound of WO_3 is recovered from each ton of molybdenum flotation tailing.

Magnetic separation rejects contain 8.0 percent tin, small amounts of pyrite, and silica, and heavy black minerals which include some rare earths. This material is fed to a 50-mesh, 18-inch-diameter, Sweco vibrating screen to remove coarse particles; undersize goes to two Wilfley laboratory tables which recover about 250 pounds per day of 40 percent Sn.

While net results in the new plant are gratifying, testing and research to

improve recovery in the byproducts plant continues. The tungsten in the minus-300-mesh sizes continues to be a problem; great care in operations to circumvent losses in this size is necessary throughout the plant.

Acknowledgments

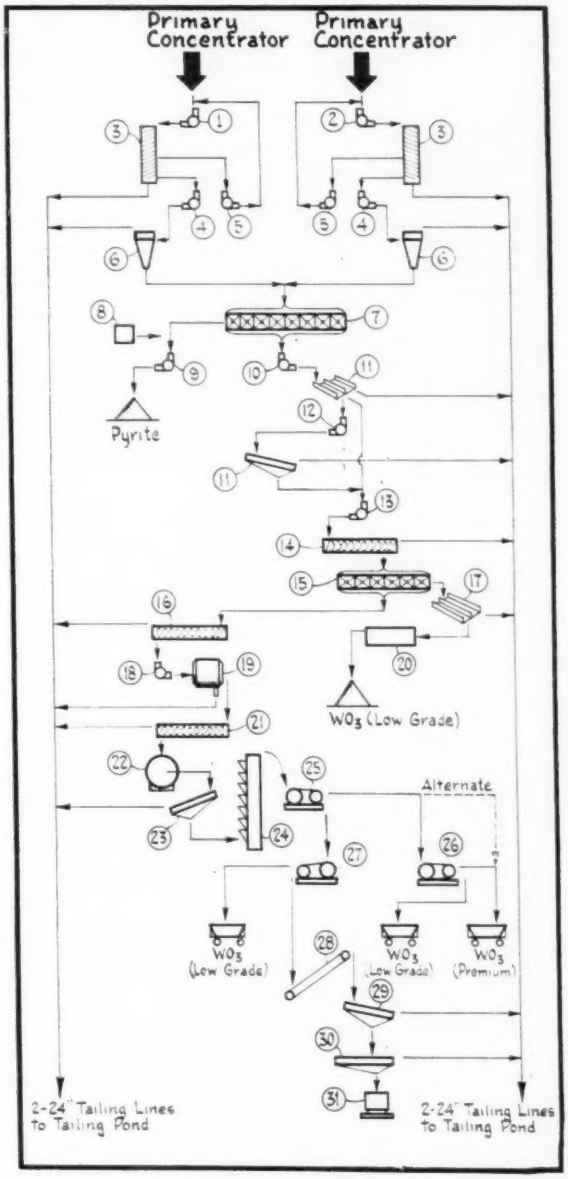
To list the personnel and their efforts over the years which are reflected in this new plant would require far more space than this article. Metallurgical research was conducted by R. E. Cuthbertson and his staff at the Golden, Colorado Climax Company laboratories, collaborating with the milling operations at Climax. Operation and testing of pilot plants through progressive expansion of production plants was conducted over the development period by the following mill superintendents and their staffs at the Climax operations—E. J. Duggan, the late Max W. Dessau, and Frank Windolph. The new plant actually evolved from the efforts of these people. A complete listing would include research metallurgists, mill operators, mill maintenance personnel, design and field engineers, electrical engineers, management personnel—in truth the entire Climax organization.

Recovery of minerals in this plant which might otherwise have been wasted points the way to one salient thought; the mining industry must attempt to recover every particle of mineral resource in every ton of ore handled. END

Climax Byproduct plant flowsheet resulted from evaluation of former facilities

LEGEND

1. 4—D-41-5 slurry type Hydroseal pumps—150 hp motor, 528 to 641 rpm (2 stand-by).
2. 2—D-6-5 slurry type Hydroseal pumps—200 hp motor, 560 to 674 rpm (1 stand-by).
3. 752 Humphreys spiral concentrators—5 turn model 24A.
4. 4—Denver 5x5 SRL pumps—10 hp (2 stand-by).
5. 4—Denver 6x6 SRL pumps—15 hp (2 stand-by).
6. 4 Krebs D-10-B cyclones (2 stand-by).
7. 2—8-cell 36" Climax Weinig flotation machines, rubber lined, 21" rubber-covered impeller, 290 rpm, 5 hp.
8. 1 Spencer turbo-compressor, model 3025-H, 115 cfm at 48 oz., 25 hp, 3,500 rpm.
9. 2—Denver 3x3 SRL pumps—15 hp each.
10. 4—Denver 3x3 SRL pumps—7½ hp (2 stand-by).
11. 20—No. 6 Deister concentrating tables, ¾" stroke, 250 spm, slime riffling on linoleum deck, 2 hp.
12. 2—Denver 2x2 SRL pumps—5 hp (1 stand-by).
13. 4—Denver 2x2 SRL pumps—5 hp (2 stand-by).
14. 1—12" Wemco classifier SH—13 rpm, ½ hp.
15. 2—8-Cell Stearns-Roger flotation machines—rubber-lined tank, 8" impellers, 575 rpm, 1 hp (1 stand-by).
16. 1—14" Wemco Classifier—5 SPS, 8 rpm, ½ hp, completely rubber-lined.
17. 1—No. 14 Deister concentrating table—250 SPM, 1½ hp, ¾" stroke, slime riffling on linoleum deck.
18. 2—1" Wilfley sand pumps—3 hp (1 stand-by).
19. 2 Dings Crockett magnetic separators—6" Belt, ½ hp.
20. 1—31"x41" batch hotplate drier, electrically heated.
21. 1—12"x9' Wemco classifier—½ hp.
22. 1 Allis-Chalmers two-stage, steam jacketed, ribbon flight drier.
23. 1—48" Diameter Sweco separator—model B-ID, screen opening 0.0165 in., wire diameter 0.0085 in., 1 hp.
24. 1 bucket elevator—6" belt, 24' high, 1 hp.
25. 1 Dings cross belt magnetic separator—18" belt, 8 poles at 40,000 Gilberts each with a 22" self-cleaning perma-plate magnet.
26. 1 Dings cross belt magnetic separator—12" belt, 4 poles at 40,000 Gilberts.
27. 1 Dings cross belt magnetic separator—12" belt, 3 poles at 30,000 Gilberts each and 1 pole at 40,000 Gilberts.
28. 1 belt conveyor—8" wide, 64' C-C, 1 hp, 3 ply ribbed belt.
29. 1—18" diameter Sweco separator—model H-ID-2, screen opening 0.011 in.



30. 1—Wilfley laboratory table—No. 13-B, 330 spm, ¼ hp, ⅝" stroke, slime riffling on linoleum deck.
    1—Wilfley laboratory table—No. 13-A, 360 spm, ¼ hp, 5/16" stroke, slime riffling on linoleum deck.
31. 3—31"x41" batch hotplate drier—electrically heated.

Condemned and Not Approved in U.S.

CHLORATE EXPLOSIVES . . . . .

Find growing use at LKAB, Kiruna, Sweden, Because they are competitive with normal Ammonium nitrate-nitroglycerine explosives

By **H. Bjorkling,** mine superintendent and **Y. Sundstrom,** head of mining research laboratory, Luossavaara Kiirunavaara Aktiebolag, Kiruna, Sweden

New blasting formula said to reduce fumes

Ventilation of the large Kiruna iron ore mine in northern Sweden is a growing problem as tonnage mined by sub level caving increases each year toward a goal of 16,000,-000 annual tons. Winter ventilation of the mine at 68° north latitude is especially costly.

The Kiruna staff began experimenting with "Imatrex" in 1957 at the nearby 800,000-annual-ton underground Luossavaara mine because it was known that Imatrex yielded no oxides of nitrogen and relatively little carbon monoxide upon detonation.

Imatrex was tested under all common blasting conditions both underground and in the open pit. Impregnated granules were used in open pit blasting; for other blasting, impregnated sticks were used. At Luossavaara the rock is hard: magnetite, quartz porphyry, syenite porphyry, and magnetite porphyry breccia.

Imatrex is a potassium chlorate treated with mineral oil

The one modern blasting preparation of alkali chlorate on the Swedish market is "Imatrex," sold by Exportaktiebolaget Norden, Stockholm. In principle, Imatrex consists of potassium chlorate, which is prepared in such a fashion that it will absorb a quantity of mineral oil that corresponds to its content of fixed oxygen. This was first achieved in the pioneering work, carried out by P. O. Björkman in the 1930's and 1940's. His two versions of the explosive are now on the market; granules and sticks with carefully adjusted porosity. The impregnation of the potassium chlorate with mineral oil, which turns it into the explosive, Imatrex, may be carried out on or near the blasting area. The following instruction for impregnation is quoted from the manufacturer's manual.

"For the impregnation of Imatrex both in the form of sticks and granules, the use of ordinary kerosine, Diesel oil, or other oils with specific weight about 0.80 and boiling point 300 to 625° F. is recommended. It should be observed that when using heavy oils, the impregnation time will be shortened if the oil is warm. Gasoline, turpentine, linseed oil, alcohol, or nitrotoluene should not be used. It is necessary to ensure that there is no water in the oil or in the container used for the impregnation.

"If impregnated Imatrex is exposed to sun or heat for a long time, the oil is liable to evaporate, and it is then necessary to impregnate again before use. The Imatrex sticks retain, even in this case, their original hardness and form. Impregnated Imatrex can be stored for a long time in a closed container without a second impregnation being necessary. When impregnated, Imatrex must be stored and handled as an explosive in accordance with existing regulations."

Swedes say chlorates can compete, cite these costs

Item	Imatrex	AN-NG Explosive
Holes per round	51	47
Feet advance per round	6.7	7.2
Cubic feet broken per round	1,380	1,500
Pounds explosive per round	131	104
Cubic feet broken per pound	10.5	14.4
Cost, Swedish Krona per foot	15.8	17.2
Cost, Swedish Krona per cubic foot	0.0756	0.0840
Cost, Dollars per foot	3.06	3.33
Cost, Dollars per cubic foot	0.0146	0.0163

Use of Imatrex was acceptable under all conditions. In the pit the results were good with favorable size distribution of broken ore, and minimum production of fines.

An underground comparison was made driving an 18.6-by 10.5-foot drift in syentite porphyry using Imatrex for one round and a standard 60 percent ammonium nitrate–30 percent nitroglycerine explosive for the alternating rounds. Results of this test are summarized in the table.

IMATREX is available in a wide range of stick sizes and in pellet form as shown in this photograph.

For wet holes sodium chlorate "Snoratrex" is used

In the course of basic research on blasting at LKAB, a number of water-containing explosives were prepared in the first half of 1959. It is well-known that an explosive will detonate, even if water is added, provided the water content is reasonable and, in the case of multi-component explosives, the usual mixture of fuel and oxygen-carrier is intact. It was found that certain cellulose derivatives, e.g., carboxymethyl cellulose act as thickeners and emulsifyers for concentrated solutions of ammonium nitrate and sodium chlorate in combination with mineral oil. Uddeholms AB, Uddeholm, Sweden kindly assisted in the pioneering experiments and found useful grades of CMC.

Imatrex is anhydrous, and so consists of potassium chlorate. The aqueous chlorate explosive, work-name "Snoratrex, is based on the cheaper sodium chlorate, whose weakness deliquiscence, now is advantage. Here is a Snoratex formula: Sodium chlorate, 72 percent; Diesel fuel, 9 percent; CMC, 2 percent; and water, 17 percent.

This very preparation of Snoratrex appears to have the same advantages as Imatrex. It has the appearance of a slightly tixotropic paste, and it has been used successfully in wet one-inch holes with a pentyl primer.

With normal ventilation, no dangerous concentration of carbon monoxide was observed in the Imatrex experiments. Potassium chloride fog occurred. This fog is not irritating and is easily eliminated with water-spray.

The drainage time for Imatrex preparation as recommended in the manual must not be shortened. END

USBM says chlorates aren't safe and won't test them

"The Bureau of Mines early recognized the danger existing in employing chlorate explosives. As a matter of policy, it does not test for use in mines any explosive containing chlorate or perchlorate as a major ingredient.

"Potassium and ammonium percholate mining explosives have been permitted to be used in the mines of England and Belgium, and in other countries.

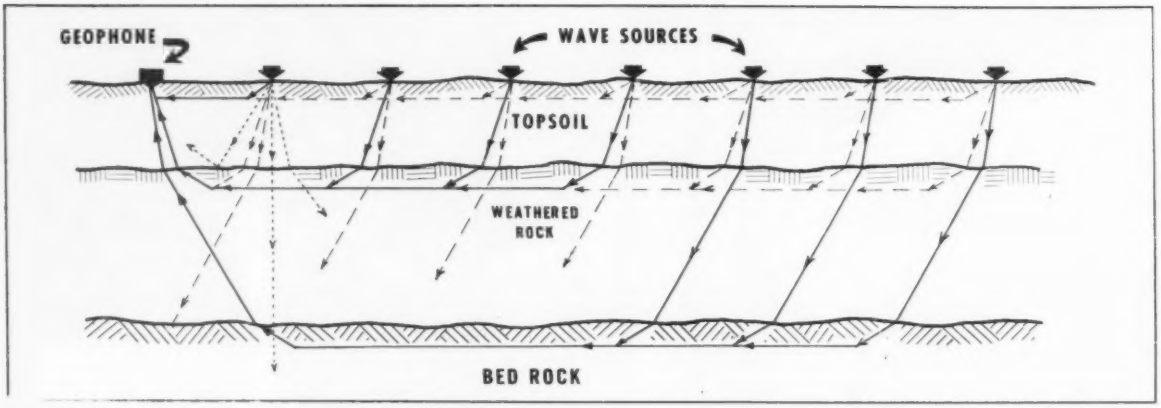
"The perchlorates possess the advantage over the chlorates that they are more stable and less sensitive.

"The mixture of combustible material with potassium chlorate must be made with the minutest precautions, as the least shock or friction may cause an explosion.

"All perchlorate mixtures are liable to what is termed spontaneous ignition or explosion in the presence of a variety of materials, more particularly of such as are acid, or are liable to generate acid; and all chlorate mixtures are readily exploded by percussion, such as a glancing blow, which might easily and would often occur in charging a hole.

"Howell found in developing the Bureau of Mines pendulum-friction device, that of all the samples tested at that time [1919], the only ones failing the fiber shoe contained either a chlorate or perchlorate."

*These passages are highlights of "Hazards from Chlorate and Perchlorates in Mixtures with Reducing Materials", U. S. Bureau of Mines I. C. 7340, December 1945, Irving Kabik.



VELOCITY of sound waves is a function of relative density and compaction of overburden. Caterpillar Tractor Company has classified various formations into a few groups. By hundreds of seismic tests, seismic velocities of each group have been correlated with actual ripper and scraper performance, providing a scientific tool for equipment selection.

NEW SEISMIC METHOD helps to determine

A quick and inexpensive method of determining the consolidation of overburden has been developed by Caterpillar Tractor Company. By use of the method, the surface mine operator can determine rippability of the overburden material and, hence, the most economical method of removing it. He can tell for example, if the material can be dozed and scraper loaded, or ripped and scraper-loaded, or if it must be drilled and blasted for shovel loading.

The method involves the use of a refraction seismograph. Study of wave patterns indicates the density of subsurface materials, the rock hardness, stratification, fracturing or jointing, and the degree of weathering or decomposition.

Caterpillar sales development engineers became interested in various methods of classifying subsurface materials with the development of heavy-duty, tractor-mounted rippers several years ago. The company was convinced that on many jobs the use of rippers could reduce earth and rock-moving costs.

Caterpillar engineers found on job after job that where rippers could be used on a production basis, dirt could be moved at lower unit cost than by other methods (see cost table).

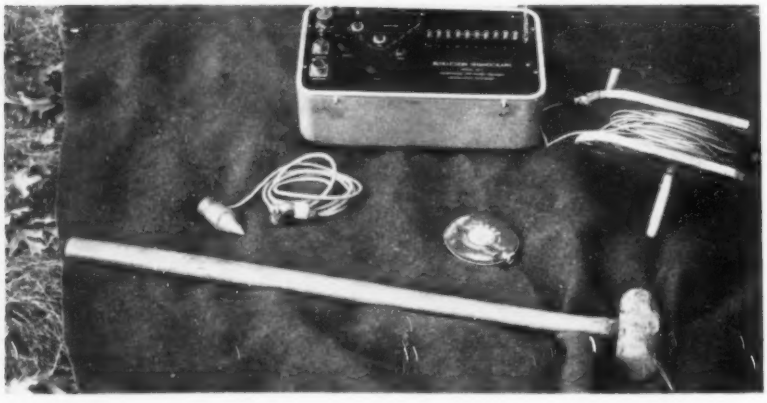
The jobs cited in the table included overburden removal and actual ripping of the quarried material. Note that the cost of loosening the material by ripping ranges from less than 12 percent to 60 percent of the cost of drilling and blasting. It should be further noted that these cost figures do not take into account the expense of moving the material. In most operations scrapers can be used to follow rippers, while shovels and trucks or wagons generally are used after blasting. Generally, this adds to the cost differential.

In view of the relative costs of ripping and blasting, Caterpillar felt that present methods for determining rippability of overburden material were either inconclusive or too costly and time consuming.

Caterpillar wanted something simpler—something a user could handle with only a few days' training—and one that would be relatively inexpensive. Introduction of the refraction seismograph for measuring overall consolidation of subsurface materials provided the answer.

The refraction seismograph works on the principle that sound, or seismic, waves travel through subsurface materials at different speeds and along different paths. Speed of a seismic wave depends upon the consolidation

Two Men Can Perform Seismic Study in a Matter of Hours



Equipment needed:

1. An 8-pound sledge hammer
2. A small steel plate
3. A coil of wire
4. A refraction seismograph
5. A geophone receiver
6. A set of tables available through Caterpillar Tractor Company

Deep Hole Drills

whether to rip overburden . . . . . or to blast it

of the material—the higher the consolidation, the higher the velocity. Path of a seismic wave varies with speed and also with the thicknesses of layers of materials with varying degrees of consolidation.

The seismic wave is produced by a sledge hammer striking a steel plate at various distances from a geophone receiver. The receiver is sensitive only to the first seismic wave that reaches it. Thus, either the seismic wave that travels the shortest path or one that travels over a longer path but which includes a high velocity segment triggers the geophone. The time interval between the hammer blow and receipt of the seismic wave at the geophone can be read directly.

It can be seen how the seismic waves traveling the longer paths can reach the geophone first. Broken lines show the paths of seismic waves which have a longer travel time and, consequently, are not detected at the geophone.

Spacing of the seismic wave sources at 10-foot intervals permits the construction of a graph of time vs. distance. The slopes of the various segments of the curve represent the velocities of the wave through each layer.

Caterpillar engineers recently completed an extensive program of correlating performance of rippers with consolidation of the ripped materials as indicated by the refraction seismograph. The range of seismic velocities for the common subsurface materials was obtained on construction and mining jobs where ripper performance was known. Over 200 tests were made in 18 states to complete this initial phase of the program.

Work has progressed to the point where rippability of a dozen common materials can be predicted with reasonable accuracy. As more data is accumulated, evaluation of materials such as shale, sandstone, limestone and caliche will be improved upon, and other materials will be added to the list, Calterpillar said.

Actual analysis of the materials on a job is simple. From 20 to 30 minutes are required to run each test and to determine seismic wave velocities. A comparison of the wave velocities with those obtained in the same materials on prior jobs will give a good indication of the ripper performance and production that may be expected. On the jobs where this procedure has been followed and where the results have been observed, the determinations of rippability have been remarkably accurate, Caterpillar engineers report.

It should be noted that the materials must first be classified as to composition, such as caliche, limestone, sandstone, or shale. Physical properties of different rocks vary in respect to their rippability even though velocities of sound waves through them are almost identical. Such classification usually is readily provided by a minimum amount of core drilling, observation of existing highwalls or outcroppings, or a general knowledge of area geology.

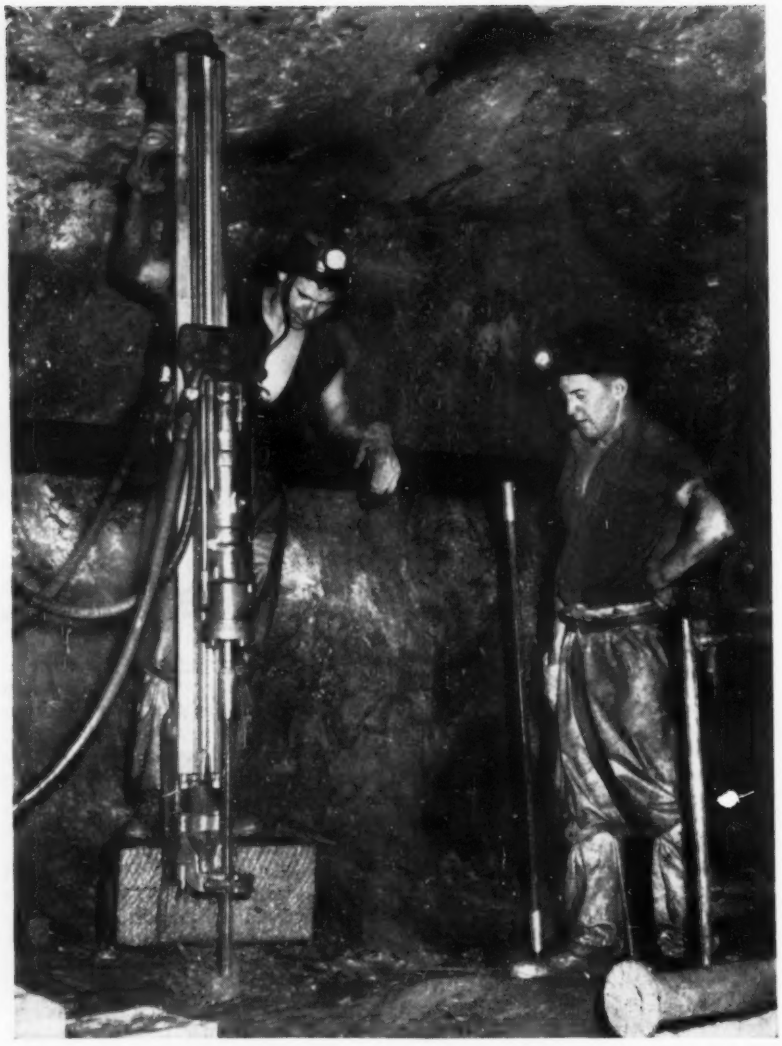
In addition to determining the degree of consolidation, or rippability, of each layer, it also is possible to determine the depth of each layer. This is an added bonus to the mining engineer.

The success of numerous seismic analyses conducted by Caterpillar engineers indicates that expensive and complicated methods of classifying materials for overburden removal are no longer necessary. END

Cost Figures Indicate Ripping Is Cheaper than Drilling and Blasting

Location	Material	Ripping Production	Ripping Cost	Drilling and Blasting Cost
		cu. yds. per hour	cents per cu. yd.	cents per cu. yd.
Tulsa, Oklahoma	Limestone	250	7.3	17.3
Dallas, Texas	Limestone	350	5.2	15.1
San Francisco, Calif.	Sandstone	400	15.0	30.0
Chicago, Illinois	Limestone	460	6.5	—
Philadelphia, Pa.	Limestone	196	11.5	19.3
Carbo, Virginia	Sandstone	300	8.6	15.7
Hibbing, Minnesota	Frost	90	25.0	60.0
Hibbing, Minnesota	Paint Rock	350	6.1	54.5

Deep Hole Drills
Drifters
Air Feed Leg Drills
Sinkers
Stopers
Broaching Drills
Chain Feeds
Screw Feeds
Hydraulic Drill Booms
Hydraulic Drill Positioners
Remote Drill Controls
Jumbo Components
Jumbo Carriages
"Air Trac"® Crawler Drills
"Mole-Drils"*
Carburized Drill Steel
Couplings
Ring Seal Shanks
Mine Car Loaders
Columns
"Airslushers"
Stationary Compressors
Rotary Portable Compressors
Grout Pumps
Slurry Pumps
Dewatering Pumps
Impact Wrenches
Air Maintenance Tools
Air Hoists
Bit Grinders
Oil Forges
Air Line Oilers
Drill Steel Sharpeners



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*Trade-Mark

New Lightweight Firebrick Has Great Strength

PRODUCTION EQUIPMENT PREVIEW

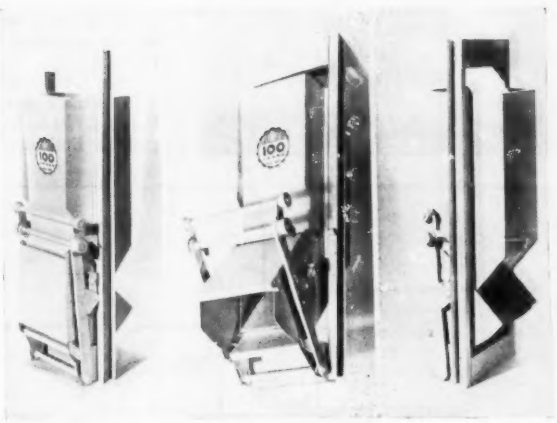
For data on any item on next three pages use the inquiry card opposite page 52

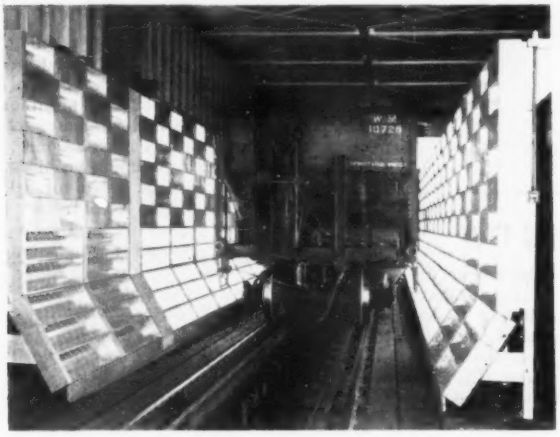
New Front Discharge Mining Skips

Made by Lake Shore, Inc., the new skips have the same door opening characteristics as the famed Jeto skip. The unit differs from other front dump skips, however, in that the door pivots from the top. The door is actuated by a special toggle linkage system which forces the hinged section against a rubber seal when closed. This is said to eliminate all possibility of spillage and makes the skip watertight.

During normal travel in the shaft, the main dump rollers of the skip are locked in position by safety hooks to insure positive locking. The skip is reported to have other desirable features, such as an enclosed chute extension from the skip when it is in the dumped position. This eliminates flying particles, cuts down on dust or splash when contents are emptied. A retractable chute is incorporated in the linkage. It extends over the bin to prevent material from falling down the shaft.

The new skip can dump within three vertical feet of travel after the skip has entered the scrolls. Unit was developed to provide a front dump skip with positive door opening. Circle No. 1.





Infrared Process Thaws Cars In Lamp Oven

New thawing process for ores, coke, and other materials is said to be exceptionally fast and clean. Reports say that the system requires a minimum of maintenance, and results in less damage to railroad cars.

The infrared process is outlined in a new brochure released by Fostoria Corporation, manufacturer of infrared ovens and other components for production heating applications. The booklet also describes Fostoria side, top and undercar thawing equipment with or without shakeout equipment.

The lamp oven has been under test at a railroad dockside yard in the East. It uses banks of G. E. 1,600 watt and 3,800-watt quartz infrared lamps to thaw frozen coal. The cars enter the oven, built by Fostoria, and pass between reflector panels of the infrared lamps. Heaviest infrared concentration is at the bottom of the car. Duration of a car's stay in the oven depends upon prevailing temperatures, how solidly the material is frozen and the moisture content.

Electrical input to the G.E. tubular quartz lamps is about 100 watts-per-heated-inch with a tungsten temperature of over 4,000° F. Circle No. 2.

V-Power for Scraper

LeTourneau-Westinghouse Company has announced a new Tournapull and points out that it is the first production earthmoving scraper powered by a V-8 Diesel. The new machine is called V-power C. Turnapull. It is a 270-horsepower machine with a 20 cubic yard heaped capacity.

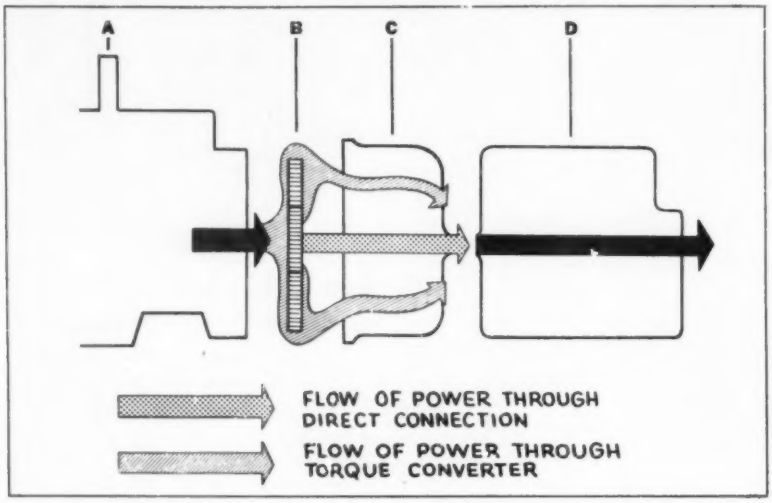
The power plant is a GM 8V-71, two cycle Diesel. It develops its rated horsepower at 2,100 rpm, while it reaches maximum torque at 1,200 rpm. L-W engineers say that the high horsepower of the unit gives it the best power-to-weight ratio in the industry. Fast acceleration is said to be a basic feature of the high power rating. Operators reach haul speeds up to 30 percent faster in the new model as contrasted to the standard powered C Turnapull.

The Fulpak scraper is said to have an instant quick drop scraper mechanism which is the fastest in the industry. L-W engineers say this feature enables operators to "pump" tough-to-load, dead materials into the scraper bowl faster than ever. The new unit also incorporates the L-W power transfer differential, which automatcally transfers 80 percent of engine power from a slipping drive wheel to a wheel on solid footing. Circle No. 3.

New Lightweight Firebrick Has Great Strength

Mechanical strength of a new insulating firebrick has been increased by more than 65 percent for B&W K-20 and more than 50 percent for B&W K-23, according to reports from the Refractories Division of The Babcock & Wilcox Company. The new firebrick is also said to be the lighest in weight and the lowest in thermal conductivity of all brands currently available. The K-20 and K-23 firebrick was engineered to meet higher structural and furnace specifications.

The K-20 has an average weight of 1.70 pounds per 9-inch straight, while the K-23 9-inch straight averages 1.85 pounds. Both are said to be the only 9-inch straight marketed today with a 2300° F. use limit that weigh less than 2 pounds. The B&W insulating firebrick can be tailor-cut, drilled or shaped as necessary, eliminating the need for costly special shapes. B&W says that only ordinary wood-working tools are necessary. Better mortar bonding and resistance to gas erosion are other important features claimed for the new firebrick. Circle No. 4.



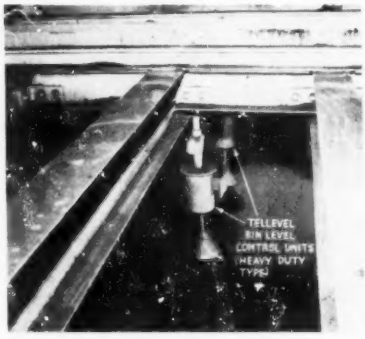
Power Shift Transmissions for Cat D-8 and D-9

The new transmissions provide instantaneous, one-lever control of gear shifting without interruption of power and momentum, states Caterpillar Tractor Company. An important feature according to Caterpillar engineers: the planetary gear set tailors power to the transmission input shaft.

The above diagram shows how this feature works. Torque is delivered by the engine (A) to a planetary gearshaft (B), driven internally by the engine flywheel. The planetary gear set-directs approximately ⅓ of the torque to the input shaft of the power shift transmission (D). The remaining ⅔ of the torque is directed into the converter (C), then to the transmission input shaft. The above arrangement is said to combine the best features of both direct drive and torque converter power trains. Circle No. 9.

Power Pipe Machine

A new machine has been designed by Toledo Pipe Threading Machine Company for threading, cutting and reaming all sizes of pipe through 2 inches and for threading ¼ to 1½-inch bolts. Special features include the ability to use the die head, cut off tool and reamer as close as ¾-inch from the chuck; an offset roller cutter provides maximum visibility of work area; a carriage travel of 10 inches is minimum. Circle No. 11.



Bin Level Control

Three new styles of Tellevel bin controls have been developed by Stephens-Adamson engineers. Each is a self contained unit with a pendant float, which operates a sensitive enclosed switch. Ordinarily the Tellevel bin control is connected for a normally closed circuit, but it can be used for open circuits as well. The bin control can be used to start or stop conveyors or to actuate warning lights or horns. Automatic control can be arranged by installing one or more Tellevel controls near the top, bottom, or at various levels in a bin or tank. Circle No. 7.

Flat Belt Pulleys Have Tire-Tread Surface

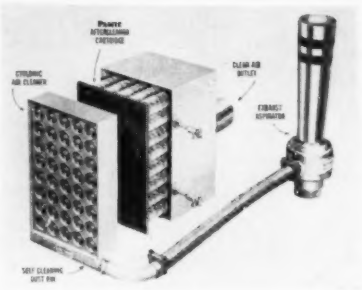
Less slippage, longer belt life, and quieter operation without use of belt dressings are advantages claimed for flat belt pulleys made by Republic Engineering & Manufacturing Company. Virtually all sizes of pulleys are carried in stock from 3⅜-inches to 16 inches in diameter. Circle No. 30.

Extra-Long Lift Arms

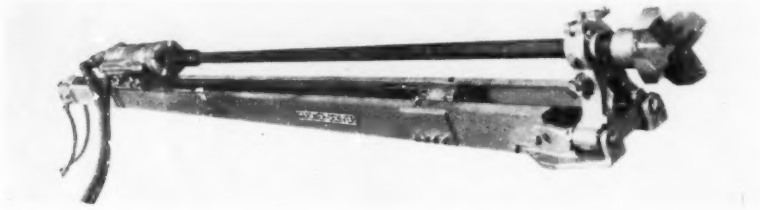
New arms that are two feet longer than standard are now available as optional equipment on Case W-9 and W-10 Terraloaders, the J. I. Case Company announced. They give both loader units a clear dump height of 11 feet 6 inches with bucket retracted and 10 feet 2 inches with bucket fully dumped. Circle No. 10.

Dry-Type Air Cleaner Developed for Engine Intakes

The new two stage filter combines a centrifugal separator with a special paper aftercleaner. It is now available from Farr Company of Los Angeles. Called the RotoPamic, it was developed for off-highway, equipment, compressors and other equipment driven by Diesel, gasoline and LP engines. It is said to provide an efficiency well over 99 percent, and reduce the expense of maintenance and down-time by more than 80 percent over conventional heavy-duty filter systems. The RotoPamic is standard equipment on the new Eimco 103 series tractors.



Certain other advantages listed by the Farr Company for the cleaner are: (1) Design resistance of 3.5 inches, water gauge (about ⅓ that of other two-stage systems); (2) self cleaning first stage (all particle over 5 microns) so that job time before service is 50 to 100 times that of conventional oil bath filters; (3) aftercleaner cartridge, which filters out particles under 5 microns, is easily replaced, usually after 400 to 1,500 hours of service; (4) cartridge change-out is from the dirty side of the intake, eliminating danger of contamination during service. Circle No. 13.

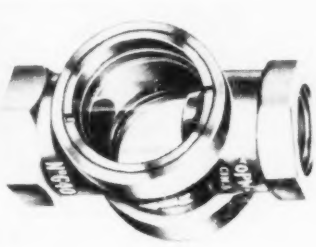


New Channel Screw Feed Mountings for Jumbo Drilling

The new 2MC series screw feeds made by Gardner Denver Company mount 4½ and 5½ percussion drills for tunnel jumbos. They are operated by remote control and controls for both the drill and the feed motor may be mounted in any location for maximum accessibility. Automatic wet controls are standard on 2MC mountings, but it is simple to convert them for dry drilling. The feed screw is lubricated by drill exhaust and is made of tubular steel with spline drive. A Gardner Denver five cylinder radial air motor powers the mounting. The motor is also self lubricated by its exhaust system. Circle No. 14.

Revolving Front End Loader

A new front end loader is built on a crawler turntable and features a full revolving swing of 360° reports Koehring Company. The unit is available with a rehandling, rock, or general purpose bucket. It is said to be capable of loading up to 400 tons-per-hour. Koehring's model 205 Skooper has independent traction, hydraulic crowd and dump assembly, and standard cable hoist. Details are described in bulletin K-636. Circle No. 17.



Hardfacing Electrode

A new, manual, tubed electrode for general purpose hardfacing is now available from American Manganese Steel Division of American Brake Shoe Company. The new rod is said to be easy to handle and features a stable, low-spatter arc with outstanding speed and build-up. The new product was developed for use where both impact and abrasion are problems. It has been proven on crusher rolls, scraper blades and dipper teeth. Circle No. 16.

Window for Pipelines

A new sight glass indicator is now available from OPW-Jordan. The unit is used in pipeline applications for visual observation of direction, viscosity, color, clarity, rate of flow and purity of liquids and pulps. The new indicator is made of aluminum, contains double windows of heavy plate glass, and is said to be suitable for pressures to 75 psi and temperatures to 225°F. The unit is available in ½ to 2-inch sizes and costs $11.45 to $21.00 depending on size. Circle No. 12.

27
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OF SLUSHER PROBLEMS

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30-ton gyratory...

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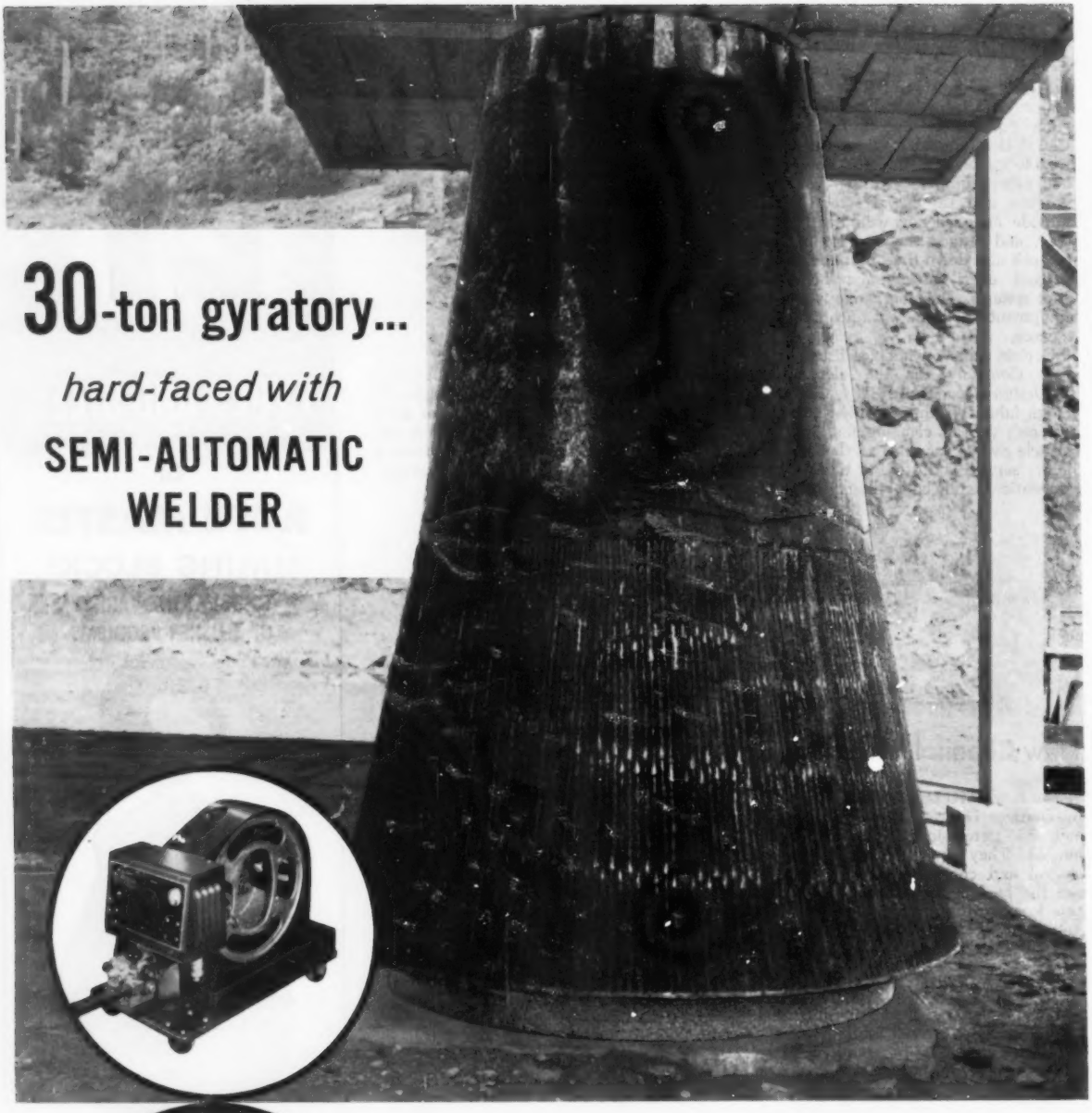

STOODY SEMI-AUTOMATIC WIRES *are available in a wide range of alloys for application through most standard semi-automatic welding machines.*

This gyratory is used in the reduction of copper ore, a tough operation that results in severe metal loss. In rebuilding the mantle, manganese bars were first welded in place with Stoody Manganese; the entire wearing area was then overlaid with Stoody 100 applied with the semi-automatic welder. 1800 pounds of weld metal were required for the job. The combination of Stoody alloys and the semi-automatic welder measurably increases service life and reduces maintenance costs on equipment subject to destructive wear. Your Stoody dealer (check the Yellow Pages of your phone book) has detailed information and will gladly demonstrate in your own shop.

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SOLUTION CONTROLLER for regulat-

NEW A-C MOTOR STARTERS have

FRONT END LOADER features a

MORE NEW EQUIPMENT . . . AND NEW LITERATURE

NEW FLOODLIGHTS feature a spring loaded construction so that the old lamp pops out at a touch and new lamp can be snapped into place instantly. The new line is made by Stonco Electric Products Co. Circle No. 40.

TRACTOR SHOVELS: Model HD-16G and HD-21G torque converter drive tractor shovels are described in a new 8-page bulletin by Allis Chalmers Mfg. Co. Circle No. 41.

LIFETIME LUBRICATION for track and carrier rollers and idlers, similar to those introduced earlier this year by Caterpillar Tractor Company are now standard on six additional machines. Circle No. 42.

NEW TRUCK TIRE has been strengthened through application of a combination of double strength nylon tire cord and tough steel cable reports U. S. Rubber Company. It was developed to take impact of off-highway terrain, but still withstand heat and wear of on-highway duty. Circle No. 44.

V-BELTS can be made up to exact lengths by industrial users under a new merchandising program made available to suppliers by Flexible Steel Lacing Company. Circle No. 45.

ICE MELTING compound said to be more economical to use and to possess greater active bulk is available from Chem Industrial Company. Made from aerated crystalline chips, it is claimed to provide 35 to 40 percent more covering capacity for walks, drives and parking areas. Circle No. 46.

REPAIR SERVICE: Cold repair of cracked or broken castings can salvage many parts normally considered beyond repair reports Metalock Casting Repair Co. Process consists of inlaying preformed alloy steel bars as locks in crack, then sealing the crack pressure-tight by overlapping tapered alloy studs. Casting is then cold worked to insure tightness. Circle No. 47.

AIR COMPRESSOR for automotive and industrial applications has been introduced by Cummins Engine Company. Advantages claimed for the unit: a 5 to 20-pound saving in weight; less space (unit is 5 inches shorter than other assemblies); and simplified air intake. It will be standard on Cummins engines. Circle No. 52.

EARTHMOVING HAULER made by Yuba Manufacturing Division features positive ejection of sticky materials and a fast ejection cycle of 11 to 14 seconds. Unit has high ground clearance and ejector push totals 140,000 pounds. Unit is made in 22 and 32 ton models with choice of tractors. Circle No. 49.

DUST MASK is said to feature a functional filtering area more than double that of most other masks. Made by Watchemoket Optical Company, the face piece is molded in one piece of plastic foam. It has a urethane filter respirator. Circle No. 50.

ALIPHATIC CHEMICALS: New 10-page catalogue of Armour Industrial Chemical Company lists specifications and chemical composition of Armour long and short chain saturated fatty acids, oleic, and unsaturated fatty acids. Circle No. 51.

WASTE HEAT PROBLEMS: Bulletin G-88 gives pointers on effective utilization of waste heat. It was prepared by Boiler Division. The Babcock & Wilcox Company. Circle No. 53.

AIR SEPARATORS: Bulletin No. 087 describes Sturtevant air separators which classify sand without water. The text points out that pre-classification by air can increase screening production by removing screen-blinding fibers. The bulletin is available from Sturtevant Mill Company. Circle No. 56.

AGITATORS: Bulletin A2-B4 covers Denver Equipment Company's line of agitators for conditioning, mixing, scrubbing, leaching, precipitation and aeration. Circle No. 57.

TESTING EQUIPMENT and metallurgical clay goods for assaying, laboratory and sample work are described by new literature available from Denver Fire Clay Company. Circle No. 58.

ROCK BITS: Bulletin 295-8 describes the complete line of tungsten carbide bits made by Joy Manufacturing Company. Designs covered include cross-type, X-type, and Rose design. Circle No. 59.

WOOD TANKS & PIPES: New information is available on kiln dried lumber and National Tank & Pipe Company know-how for engineered tanks and pipelines meeting mining industry specifications. Circle No. 60.

DUST CONTROL: Use of a new surface active agent sprayed on ore stockpiles or stored rock to prevent dust problems caused by wind or materials handling transfer points is described by bulletin CJ-1. Product is available from Johnson-March Dust Control Engineers. Circle No. 61.

INSTALMENT PLAN to increase the sales of mining equipment made by Pettibone Mulliken Corporation has been announced. The plan offers extended instalment terms to industrial purchasers. Circle No. 27.

NEW POWER TERMINAL contains in one package the pulley, motor, transmission, and brake or backstop (optional). The drive is available for pulley speeds ranging from 50 to 700 feet-per-minute and in horsepower ratings of ¾ to 50. The units are made by J. D. Christian—Engineers. Circle No. 28.

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31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	81	82	83	84	85	86	87	88	89	90
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	91	92	93	94	95	96	97	98	99	100

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SOLUTION CONTROLLER for regulating concentrations of caustic, acidic or aqueous solution automatically has been developed by the Electro Mechanisms Corp. Circle No. 19.

ANALYTICAL BALANCE: A new 12-page catalog, offered by Burrell Corporation, lists seven different balance types, including new thermo-recording and micro-chemical balances. Circle No. 20.

REPLACEMENT PARTS for all makes and models of crawlers, shovels, cranes and draglines are listed in a 4-page bulletin by Kensington Steel Division of Poor & Company. Circle No. 21.

HYDRAULIC DREDGES: Ellicott Machine Corporation traces the development of modern hydraulic dredges in a 4-page report which discusses principles and design considerations. Circle No. 22.

MULTI-STATE CENTRIFUGE of unique design has been licensed for production on the North American continent to Baker Perkins, Inc. It was developed by a Swiss firm, Escher Wyss Ltd., and is said to be capable of handling material with particle sizes down to 50 to 100 microns. Applications may exist in potash and other mineral processing. Circle No. 23.

SKID-PROOF SURFACES obtained by application of emergy and epoxy resin is described in a bulletin by Walter Maguire. The bulletin discusses properties and provides instruction for mixing and applying indoors or outdoors on practically any kind of surface. Circle No. 24.

FILTER PATCHING CEMENT for repairing holes in press cloths, centrifuge bags and rotary vacuum filter cloths has been developed by Technical Fabricators, Inc. The solvent type cement dries by evaporation, leaves a tough film having resistance to acids and alkalies. Circle No. 6.

NEW A-C MOTOR STARTERS have been designed for medium voltage motors driving heavy production equipment such as crushers, and ball mills. Called Limitamp Control, General Electric Company reports that the starters feature a draw-out contactor and fuse-shelf assembly. The controllers were developed to provide short-circuit protection and coordinated control for synchronous and wound-rotor motors up to 3,000 hp rated from 2300 to 4600 volts. Circle No. 25.

COUPLINGS: An expanded line of Paraflex flexible cushion couplings ranging from fractional to 190-hp per 100-rpm is described in a new 12-page bulletin by Dodge Mfg. Corp. Circle No. 26.

HEAT EXCHANGE TUBES: New Lectrosonic heat exchanger tubes made by Tubular Products Division of The Babcock & Wilcox Company are described in a new technical bulletin TB-431. Circle No. 39.

JIB CRANES that feature a square column are described in a folder prepared by R. G. LeTourneau, Inc. The cranes have full 360° swing and can be supplied with manual or power rotation. Circle No. 43.

CHEMICAL and process pumps are illustrated and described in a new catalog published by Lawrence Pumps, Inc. Circle No. 48.

SPRING CLUTCHES in bore sizes from 1/8 to 1-inch and torque capacity to 1,250 pounds are described by new catalog issued by Marquette Division, Curtiss Wright Corp. Units are designed specifically for use in machinery and instrument applications utilizing drive up to 5 horsepower. Circle No. 54.

IN-THE-HOLE ROTARY RIG has been developed by Junction Bit & Tool Co. for drilling in ground containing moderately hard ribs. The unit fits standard roller cone rock bits and is an auxiliary to the ordinary drill rig. Circle No. 55.

FRONT END LOADER features a crawler mounting that provides for 300° swing. Made by Koehring Company, the new model 205 Skooper is described in an 8-page bulletin. It is said to be capable of handling up to 400 tons per hour. Circle No. 29.

CAT BUYERS GUIDE outlines three different guarantee programs available for purchase of used equipment. The booklet describes "Bonded Buy," "Certified Buy," and "Buy and Try." It is available from dealers or from Caterpillar Tractor Company's home office. Circle No. 32.

RUBBER PRODUCT that is harder than conventional rubber compounds and which possess two to four times the strength of conventional rubber is described in an 8-page brochure by Goodyear Tire & Rubber Company. Product is called Neothane castable polyurethane rubber. It can be cast into shapes. The bulletin is slanted for design, development and research engineers. Circle No. 5.

INDUSTRIAL GASES are described in detail in a 32 page booklet which lists commercial applications. It was prepared by Air Reduction Pacific Company. Circle No. 33.

NEW LOADER with front end bucket has been developed by Allis Chalmers Mfg. Co. The model is TL-16 Tracto-Loader and it weighs 18,000 pounds. Carrying capacity is 7,000 pounds. Bucket size ranges from 1¾ to 4 yards. Circle No. 34.

BIN CONTROL: A consolidated catalog is available for three products made by Bin-Dicator Company for all bulk material, level indication and control. Schematic drawings and specifications are included. Circle No. 35.

NEW GENERATOR PLANTS made by Thor Power Tool Company feature a vertical shaft engine drive, which is said to eliminate horizontal and vertical loads on engine drive shaft. The new unit weighs 95 pounds for a 1,500 watt set. Also available are 2,500 and 3,000 watt sets. All are mounted in light, tubular frame. Circle No. 36.

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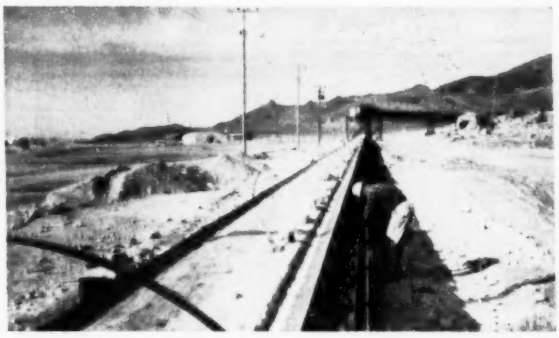
Belt Conveyor Operating and Maintenance Tips

By J. R. Brandon, service manager, Hewitt-Robins Incorporated, Stamford, Connecticut

Regular inspection, daily and weekly, is of prime importance for a well maintained, trouble-free, belt conveyor system.

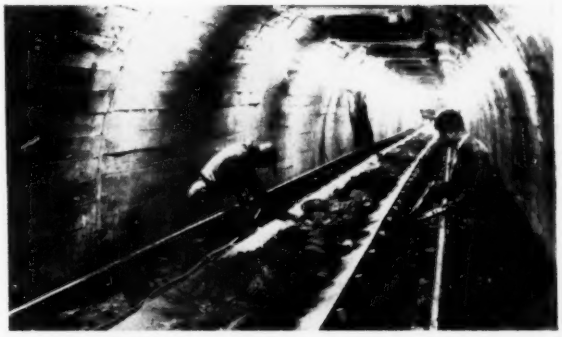
The maintenance patrolman on the conveyor system should be responsible for making quick examinations each day, so that any danger spots are immediately reported and the conveyor shut down for emergency repairs. Here are some points for your daily check list:

See that belt is properly trained and does not contact steel structure. This is important on return run which is hard to inspect. Watch for spillage onto return strand where it will get between belt and pulleys. Breaks, gouges, and checks in belt should be marked and reported for early repair. See that feed is centered on belt and that belt is not overloaded.



Lubrication plays a vital part in trouble free-operation by dissipating heat caused by deformation of load carrying members, by preventing rust or corrosion on bearings, and protecting bearings against foreign materials. Many years experience has shown that bearing failure on idlers is caused by abrasion from foreign material due to improper lubrication.

Use a bearing lubricant that resists leakage through grease and dust seals, and protects against corrosion. Tests have conclusively proved that calcium base cup grease of No. 2 consistency are the best for idlers. The tendency is to overlubricate. Under normal service conditions, relubrication with proper grease is necessary every 4,000 hours of operation. Disassemble a representative idler on your belt to see how long grease lasts.

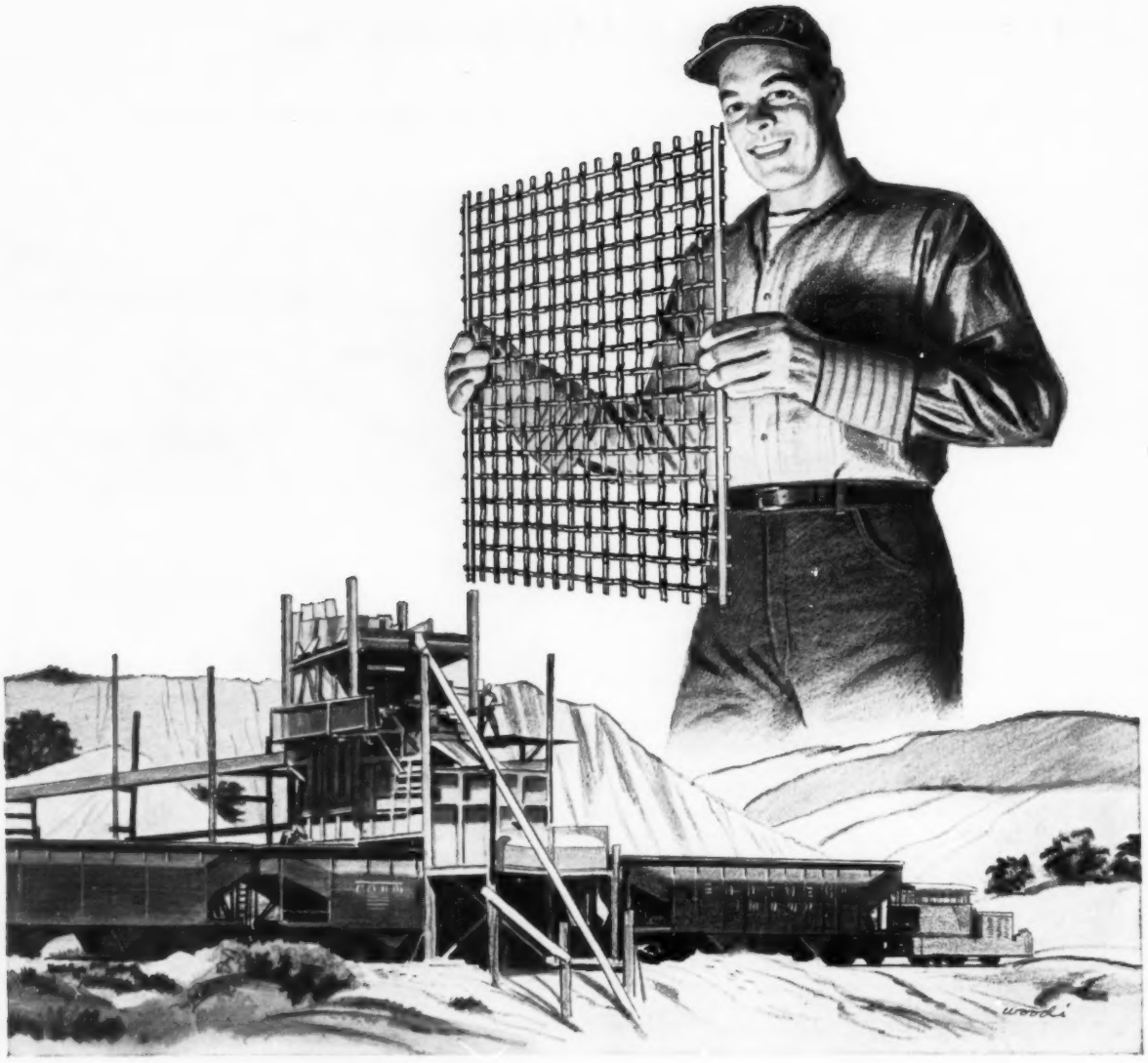


Skirtboards must always be used at loading points to center material. The boards themselves can be made of wood or steel, but must never come closer to belt than two or three inches. Close the gap with rubber extending to the belt. Don't use old belting for this purpose since the carcass provides too much rigidity and wears grooves in main belt. In addition, fines become trapped in carcass and act as a cutting abrasive on belt. Especially designed skirtboard rubber is available and should be used.

Skirtboards should be installed so that they taper outward and lift slightly off the belt in the direction of travel. The picture shows how skirtboards channel the material onto the center of the belt. Note how they are set back from edge of belt.

Belt cleaning is most important to prevent build-up of material on return idlers as shown in photograph. This usually causes the belt to run off center creating spills, belt rubbing, extra tension etc. Any build-up usually means that additional belt cleaning by combinations of scrapers, water sprays, or squeegees is necessary. Some materials, due to their adhesive nature, can't be satisfactorily cleaned or scraped from a belt. In such cases the use of rubber disc idlers, or rubber sleeves installed over standard idlers, may be necessary on the return run of the conveyor. Brushes and scrapers can also be used to help prevent sticky material becoming trapped between belt and pulleys.

Use a notched chute mouth or screen in chute bottom to spread fines on the belt to cushion the impact of large heavy abrasive chunks.



CF&I Space Screens

reduce cost by cutting downtime

This Image—the CF&I giant—reflects CF&I's experience and versatility as a *primary producer* of quality steels and hundreds of steel products for industrial uses.

The CF&I Image is your assurance that the steel in every CF&I Space Screen is chosen for its ability to perform under the specific conditions found on the job. These durable screens hold screening-cost-per-ton to a minimum by ensuring fewer work stoppages while screens are repaired or replaced.

Because CF&I makes and fabricates its own steel, careful quality-control procedures are possible all along the line—from blast furnace to wire drawing and weaving. And a wide range of screening specifications are provided to satisfy various job requirements.

For engineering assistance and prompt, dependable service, call the CF&I sales office nearest you.

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Metal & Mineral Prices

U.S.A.

METALS

October 16, 1959

COPPER: **Electrolytic.** Delivered F.o.b. cars, Valley basis (pound) ..... 30.00-31.50¢
Lake. Delivered, destinations, USA ..... 31.50¢
Foreign. Delivered, destinations, USA ..... 31.50¢
Custom ..... 33.00¢
LEAD: **Common Grade.** New York (Per pound) ..... 13.00¢
Tri-State Concentrate, 80% lead, per ton $156.12
ZINC: **Prime Western:** F.o.b. E. St. Louis (Per Pound) ..... 12.00¢
Prime Western: Delivered New York ..... 12.50¢
Tri-State Concentrate, 60% zinc, per ton $72.00
ALUMINUM: **Primary 30 Pound Ingots (99% plus)** (Per pound) 26.80¢
ANTIMONY: **Lone Star Brand. F.o.b. Laredo, in bulk** (Per pound) 29.50¢
BISMUTH: (In ton lots) price per pound $2.25
CADMIUM: **Sticks and bars.** 1 to 5 ton lots Price per pound .. $1.40
COBALT: **97.99%,** keg of 550 pounds (Price per pound) $1.75
COLUMBIUM: **Powder** ..... Nom., per pound $55.00-$85.00
GERMANIUM: dioxide, high purity, gram ..... 18.50¢
LITHIUM: **98%** (per pound) ..... $9.00-$12.00
MAGNESIUM: **Ingots (99.8%)** F.o.b. Velasco, Texas, per pound 36.00¢
MERCURY: **Flasks.** Small lots, New York ..... $225.00-$227.00
NICKEL: **"F" Ingots (5 pounds).** F.o.b. Port Colbourne, Ontario 75.50¢
PLUTONIUM: To July 1. 1962 AEC will pay $30.00 to $40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram $30.00
SELENIUM: **99.5%, per pound** $7.00
TELLURIUM: Common grade, Per pound $2.50
THORIUM: per kilogram $43.00
TIN: **Grade A Brands.** New York (Per Pound) Prompt delivery $102.375
TITANIUM: **93.3%** + Grade A-1 Sponge (Per pound) ... $1.50-$1.60
URANIUM: **Rod** (0.790 U-235) $16.00 Per Pound; Foil $16.75
U-235: **Nominal** (Per pound) $7,725
GOLD: **United States Treasury Price** ..... $35.00 per ounce
SILVER: **Newly mined domestic.** U.S. Treasury price per ounce 90.5¢
Foreign Handy Harmon ..... 91⅜¢
PLATINUM: Per ounce ..... $77.00-$80.00
ZIRCONIUM: **Sponge,** Per pound, Reactor Grade $5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: **10 to 12% BeO.** F.o.b. mine, Colorado $46.00 per unit Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $48.00.
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons,
African (Rhodesian). 48% CR_2O_3. 3 to 1 Ratio .... $40.00-$42.00
African (Transvaal). 48% Cr_2O_3. No ratio ..... $28.00-$30.00
Turkish, 48% CR_2O_3. 3 to 1 chrome-iron ratio .. Nominal $45.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.
COLUMBIUM-TANTALUM ORE: Per Pound Pentoxide Nominal $1.00
IRON ORE: **Lake Superior. Per gross ton Lower Lake Ports**
Mesabi, Non Bessemer, 51.5% Fe $11.45
Mesabi, Bessemer, 51.5% Fe $11.60
Old Range Non Bessemer $11.70
Old Range Bessemer $11.85
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit 25.00¢
MANGANESE ORE: **Metallurgical grade.** 48 to 50% Mn Long ton unit ..... $1.00-$1.05
Metallurgical grade. 46 to 48% Mn. Long ton unit. .. $0.95-$1.00
Metallurgical grade. 44 to 46% Mn. Long ton unit .. $0.85-$0.90
Domestic U.S. Government. GSA Basis $2.30 per unit for 48% mn.
MOLYBDENITE CONCENTRATE: **90% MoS_2 F.o.b.** Climax, Colorado. Per pound Mo, plus container cost $1.25
TUNGSTEN CONCENTRATE: **Domestic.** 60% WO_3 Per short ton unit ..... Nominal $24.00
Foreign: 65% WO_3 Per short ton unit (Scheelite) .. Nominal $17.00
Foreign: South American, Spanish, Portuguese .... Nominal $16.00
URANIUM ORE. F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is $1.50 per pound of U_3O_8 in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum **4.25 specific gravity,** per short ton $16.00
BENTONITE: **Minus-200mesh.** F.o.b. Wyoming. Per ton, carload lots $12.50
Oil Well grade. Packed in 100 pound paper bags $14.00
BORON: technical grade .. F.o.b. Boron California. Per ton $47.50
FLUORSPAR: **Metallurgical grade.** 72.5 % effective CaF_2 content per short ton F.o.b. Illinois-Kentucky mines ... $37.00-$41.00
Mexican. 70% F.o.b. border ..... $26.00-$27.00
Acid Grade. 97% CaF_2, Bulk, F.o.b. mine ..... $45.00-$49.00
PERLITE: **Crude:** F.o.b. mine per short ton ..... $3.00 to $5.00
Plaster grades. Crushed and sized. F.o.b. plants .... $7.00 to $9.00
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas $25.00
Export ..... $24.00-$25.00

London

October 16, 1959

Per Long Ton USA Equivalent cents per pound*

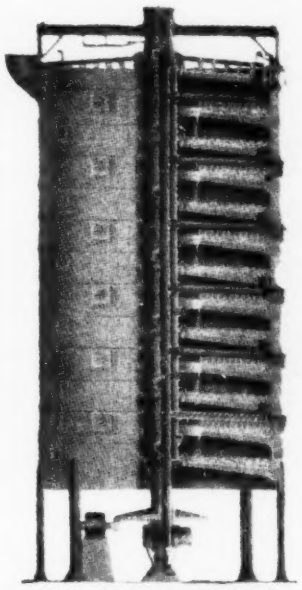
COPPER:	**Electrolytic spot**	£232	0s 0d	29.03¢
LEAD:	**Refined 99%**	£ 70	10s 0d	8.81¢
ZINC:	**Virgin, 98%**	£ 86	17s 6d	10.86¢
ALUMINUM:	**Ingot, 99.5%**	£180	0s 0d	22.50¢
ANTIMONY:	**Regulus, 99.6%**	£197	10s 0d	24.69¢
TIN:	**Standard, 99.75%** ...	£794	0s 0d	99.25¢
TUNGSTEN:	**Long ton unit**	140s		$19.60

***With Sterling Pound at $ 2.80**

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, N. Y.*

PACIFIC FURNACE

MULTIPLE HEARTH FURNACE



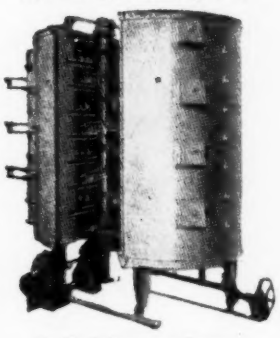
SIZES 8' 6" to 22' 3" DIAMETER
NUMBER OF HEARTHS, 1-16

ROASTING
CALCINING
DRYING

ZINC ORES	QUICKSILVER
IRON ORES	MAGNESITE
COPPER ORES	LIMESTONE
TIN ORES	MOLYBDENUM
NICKEL ORES	BONE CHAR
LEAD ORES	DIATOMITE
SODA ASHES	LIME SLUDGE
FULLERS EARTH	MAGNESIUM
CARBON	CLAY GRANULES
PYRITE	ANTIMONY

SELENIUM
SEWAGE SLUDGE
LEAD CHEMICALS
METALLIC SLUDGES
FILTERING MEDIA

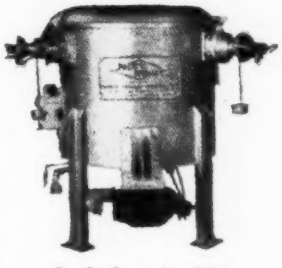
And for Numerous Other Materials



Pacific Laboratory Furnace

PACIFIC LABORATORY FURNACE

Manufactured in two sizes—36" and 54" inside diameters having 6-8-10 Hearths and include the same features as the commercial size furnace.



Pacific Furnacing Unit

NEW
PACIFIC FURNACING UNIT

Higher shell height. Three gas burners. Provision for conversion to muffle unit. Small volume roasts at any desired temperature.

PACIFIC FOUNDRY COMPANY, LTD.
Engineers and Metallurgists

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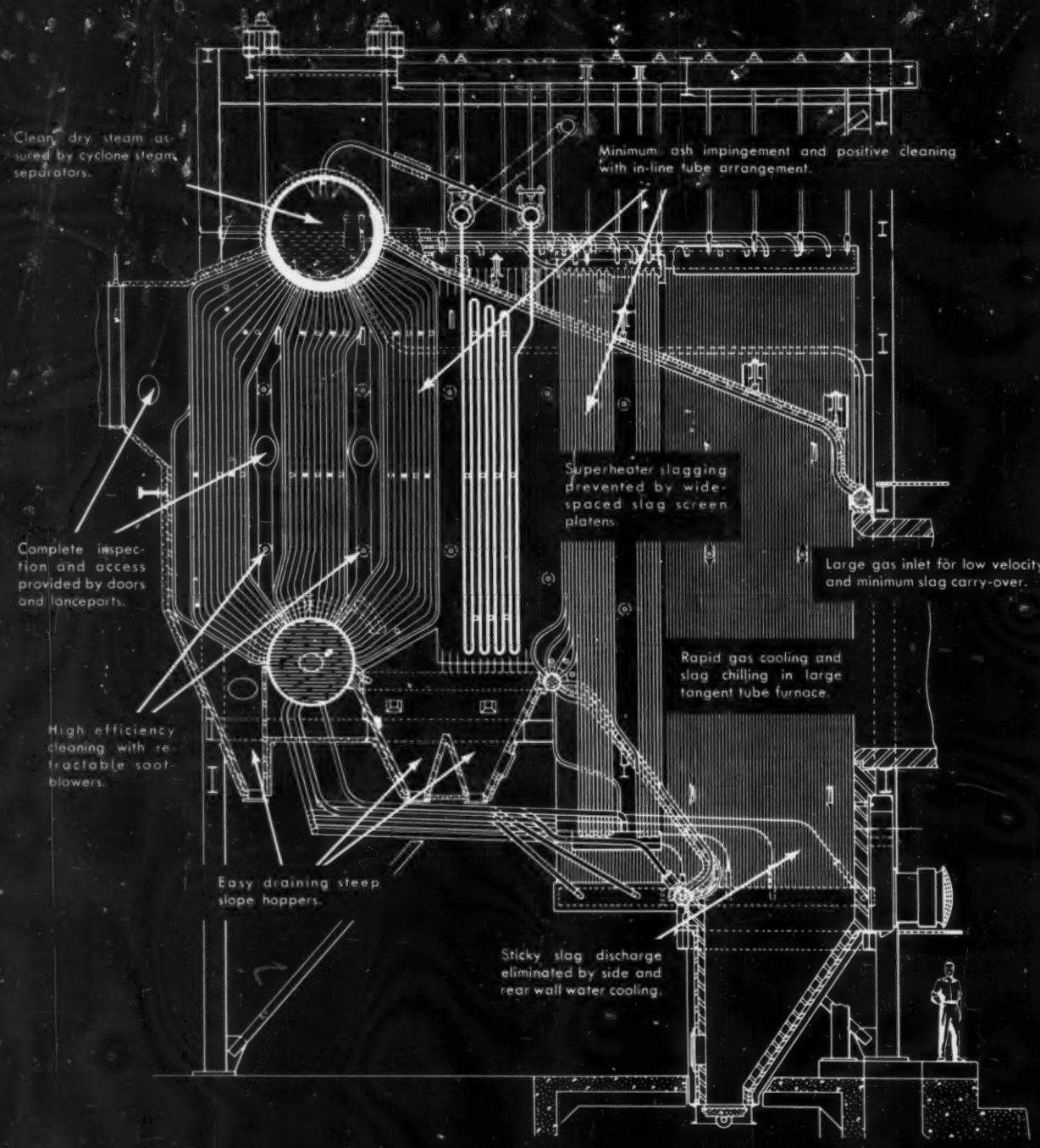
Clean, dry steam assured by cyclone steam separators.
Minimum ash impingement and positive cleaning with in-line tube arrangement.
Superheater slagging prevented by wide-spaced slag screen platens.
Complete inspection and access provided by doors and lanceports.
Large gas inlet for low velocity and minimum slag carry-over.
Rapid gas cooling and slag chilling in large tangent tube furnace.
High efficiency cleaning with retractable soot-blowers.
Easy draining steep slope hoppers.
Sticky slag discharge eliminated by side and rear wall water cooling.

These important design features assure trouble-free, continuous operation of this B&W Waste Heat Boiler

Empresa Nacional de Fundiciones, Paipote, Chile, uses this B&W Waste Heat Recovery Boiler to produce 42,500 lb steam per hour at 400 psig and 700 F at the superheater outlet.

HOW TO SOLVE WASTE HEAT BOILER PROBLEMS

B&W heat recovery system ends production bottleneck

A major problem in waste heat boiler operation is the fouling of steam generating surfaces by slag and ash from the process. Frequent outages and excessive labor for boiler cleaning add substantially to the cost of any plant operation. Production delays can result in further serious losses.

For example, the Empresa Nacional de Fundiciones copper smelter at Paipote, Chile was experiencing difficulty in handling high temperature corrosive gases with considerable slag and metallics carryover. Slagging of boiler surfaces was severely limiting plant production. Unscheduled smelter shutdowns resulted in excessive refractory maintenance, high operating costs, and production losses.

B&W's engineers were asked to design a boiler to provide trouble-free operation for these difficult ash and slag conditions. An important requirement was that the new system be installed without interrupting plant operation. Utilizing the extensive experience gained from similar installations, B&W recommended a special, single pass, low draft loss boiler for the specific plant conditions at Paipote. B&W's recommendations for a completely engineered system were accepted and a waste heat boiler, flues, dust handling equipment, and auxiliaries were furnished.

The successful elimination of the waste heat handling problems, previously limiting production and causing high maintenance costs, has now been proved by several months of operation. In fact, plant production is now above design capacity.

B&W's extensive research and engineering facilities, plus its broad field experience in design and operating requirements in the metallurgical process industry, are available to solve your problems. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

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ME-100

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

per hour at 400 psig and 700 F at the superheater outlet.

Entrance to Mont Blanc tunnel from the Italian side where Impresa Condotte d'Acqua has bored more than 500 meters of tunnel using Eimco equipment.

Eimco tractor-excavator near the Mont Blanc tunnel site and the Eimco-Italia service van.

Ever since Hannibal made his historic crossing of the Alps, men have dreamed about tunneling a roadway through Europe's highest peak, 15,781 foot Mont Blanc. This tunnel now is becoming a reality with Eimco 105 Tractor Excavators being used for mucking. This will be the world's longest (7.5 miles) vehicular tube and will link France and Italy with an all-weather highway when completed in 1961.

Tunnel crews working from both the French and Italian sides are using Eimco equipment — because Eimcos have a reputation around the world of doing rock and earth moving tasks efficiently, safely and F-A-S-T!

FLEXIBLE POWER FOR TUNNEL WORK — The Big € lifts large chunky boulders, over 10 tons, without need for breakup . . . Cushioned torque converter, unidrive power, with up to 39,000 pounds of breakout force, automatically matches the gear to the load!

EASE OF OPERATION — In restricted areas like a tunnel, the Eimco Excavator really stands out. No turning to discharge load. Fastest possible loading cycle. Minimum operator fatigue because there is no more tugging at levers nor pushing on foot pedals. Operators get instant response from finger-tip controls.

LOW MAINTENANCE — Superior, quality controlled construction from the pouring of metal to finished product . . . sealed anti-friction bearings, extra heavy heat treated steel pins and bushings . . . Simplicity of Unidrive transmission . . . No master clutch to wear out or service . . . Just a few of the reasons why Eimco machinery is on the job day after day, hour after hour.

For more information about why EIMCO is the machine for your specific operations, contact an EIMCO sales-engineer at the sales office nearest you, or write to The Eimco Corporation, P.O. Box 300, Salt Lake City 10, Utah

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MEN WHO MAKE NEWS IN U.S.

D. F. INGVOLDSTAD

MILES P. ROMNEY

DR. J. L. GILLSON

DR. S. MUESSIG

DR. JOHN S. BROWN

CHARLES HAUSEN

Donald F. Ingvoldstad, present smelter chief research metallurgist with Bunker Hill Company, Kellogg, Idaho, has been promoted to assistant smelter superintendent. Mr. Ingvoldstad has been with Bunker Hill since 1936.

Miles P. Romney, manager of the Utah Mining Association, has been named chairman of the national Emergency Lead-Zinc Committee to succeed **Charles E. Schwab.** Mr. Romney has been employed as geologist and field engineer for United States Smelting, Refining and Mining Company in Salt Lake City, Utah, and as general manager of Duvall Company, Idaho. He will retain his position with the Mining Association, which he has held since 1952.

Otis W. Allen has been appointed research specialist at International Minerals & Chemical Corporation's research engineering and development division at Mulberry, Florida. He will serve as the division's expert on phosphate technology.

Ivor G. Pickering has been named general manager of the new Kennecott Refining Corporation electrolytic refinery, south of Baltimore, Maryland. Mr. Pickering was project manager during the planning and construction phases of the new copper refining facility.

J. Bruce Clemmer, head of the Salt Lake Research Station of the United States Bureau of Mines, has been named one of the federal government's "super grade" scientists, and will henceforth devote all his scientific energies to research. Mr. Clemmer was a recipient of the 1956 MINING WORLD Technological Achievement award for application of solvent extraction to uranium.

Robert H. Raring, project engineer for Western-Knapp Engineering Company, San Francisco, California since 1956, has been named business development engineer for that company. Mr. Raring has been associated in both operational and administrative capacities with gold and copper mining operations in Nevada and gold mining operations in British Columbi and Portovelo, Ecuador.

Jack H. Morrow, former operating engineer at the Homer-Wauseca mine of the M. A. Hanna Company in Michigan, has been named assistant superintendent of the operation. Mr. Morrow has been with the Hanna Company since his graduation from the Wisconsin School of Mines in 1942.

Dr. Joseph L. Gillson, chief geologist of E. I. du Pont de Nemours & Company, Wilmington, Delaware, has been elected president of the American Institute of Mining, Metallurgical, and Petroleum Engineers for 1960. Dr. Gillson was with the United States Geological Survey, 1920-1926, and an associate professor at Massachusetts Institute of Technology from 1922-1928, before beginning his career with du Pont in 1928.

Dr. Siegfried Muessig has been appointed chief geologist for United States Borax & Chemical Corporation with headquarters at Los Angeles, California. Dr. Muessig joins U. S. Borax after eight years with the mineral deposits branch of the United States Geological Survey.

Dr. Frank G. Snyder has been appointed chief geologist for the Southeast Missouri Mining and Milling Division of St. Joseph Lead Company. Dr. Snyder, who received his PhD. from the University of Wisconsin, moved to the Lead Belt in 1951, prior to which he had been teaching geology at the University of Tennessee.

William P. Nicholls has been elected president of the White Pine Copper Company of White Pine, Michigan. He has been associated with the Copper Range Company, White Pine's parent firm, for more than 35 years, and has been serving as general manager of White Pine. He succeeds **William P. Lally,** who has resigned.

Milton A. Lagergren has been named project engineer in the Western Mining Division's Engineering department of Kennecott Copper Corporation, at Salt Lake City, Utah. He will be assigned to the metallurgical consulting engineering section of the department.

Thomas M. Ware, president of International Minerals & Chemical Corporation, Skokie, Illinois, has been named chief executive officer of the corporation. Mr. Ware has been with IMC for 12 years, and has acted as chief engineer, vice president of engineering, and administrative vice president before becoming president in May 1958.

Robert B. Aitchison, consulting engineer for Linde Company, Division of Union Carbide Corporation, will receive a John Price Wetherill Medal from the Franklin Institute "in consideration of his development of the Jet-Piercing process as applied to open-pit mining and quarrying."

Dr. John S. Brown has retired after 34 years of service as chief geologist with St. Joseph Lead Company, Bonne Terre, Missouri. During his tenure with St. Joe, he aided expansion of activity at properties in upper New York state and made the initial geological study leading to the development of the Aguilar properties in Argentina. The internationally known geologist and author will reside in Towson, Maryland.

Charles B. Hausen, assistant smelter superintendent for the Bunker Hill Company, Kellogg, Idaho, has been named corrosion engineer. Since joining Bunker Hill in 1932, Mr. Hausen has been superintendent of various plant operating departments and research metallurgist in the smelter research department.

Howard B. Nicholas has joined the firm of Hawley and Hawley, assayers and representatives in Douglas, Arizona, as chief chemist and laboratory manager. Mr. Nicholas has been a chemist with the Nevada Consolidated Copper Corporation at McGill, Nevada, chief chemist for the Metal Reserve Corporation, Desert Silver Branch, and research and testing engineer at the Inspiration Consolidated Copper Corporation at Inspiration, Arizona. In his new position, he will also be available for consultation in the fields of analysis and various modern extractive processes including ion-exchange, spectrochemical analysis, and metallurgy of the rarer elements.

Richard W. Mieritz, consulting geologist of 3420 E. McDowell Road, Phoenix, Arizona has recently expanded his services to include aerial prospecting, mapping and petroleum geology. Mr. Mieritz is the author of an article on diamond mining in Brazil which appeared in the January issue of MINING WORLD and WORLD MINING.

Edward L. Clark has been appointed director of the Department of Natural Resources for the state of Colorado. Mr. Clark has been associated with the Four Corners Oil & Minerals Company, Grand Junction, Colorado since 1955, and was state geologist for the state of Missouri prior to that time.

John M. Haivala has been named general superintendent of mines at the Chino Mines division, Kennecott Copper Corporation, Santa Rita, New Mexico. Prior to joining Kennecott, Mr. Haivala worked for Cleveland-Cliffs Iron Company at Negaunee, Michigan for 18 years.

UPGRADING AND SHARP CLASSIFICATION WITH KREBS INTEGRAL 2-STAGE CYCLONES*

The three-products feature of this cyclone design creates profits by upgrading ores of iron, chrome, manganese, copper, gold, glass-sand, alumina, and other industrial minerals. The Krebs integral two-stage cyclones are a standard method used ahead of spirals for upgrading in iron washing plants—see photo.

Applications are diverse. A copper concentrator uses them on full tonnage, rejecting an essentially minus 15 micron slime from the primary cylinder, with the secondary overflow being the flotation feed, and the small tonnage of underflow reground and recycled.

While most of the 20 Models and the vast majority of Krebs Cyclones in operation are single-stage, 70 plants have installed the two-stage cyclones to obtain the most efficient upgrading.

This is only one of many Krebs Cyclone design developments in the past 10 years. Recent work indicates even wider applications and economic advantages with the Krebs integral two-stage cyclones.

Where upgrading or a sharp classification may be significant to your operations, we invite you to make use of our Pilot Plant facilities and staff of cyclone specialists.

*Patented

EQUIPMENT ENGINEERS INC.

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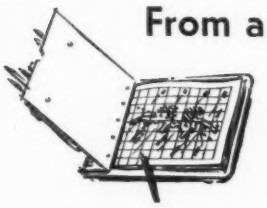


From a Geologist's Notebook

Carolina's Forgotten Gold

Recently revived interest in gold mining brings to mind the Cabarrus gold district in North Carolina. The initial discovery of gold was in 1799, probably the earliest discovery of gold in North America by white men.

The first nugget, weighing 17 pounds, was found in Meadow Creek by Conrad Reed, a 12-year-old boy. Conrad took the stone home where it was used as a door stop for over two years.

In 1802, John Reed, father of the boy who found the nugget, took it to Fayetteville, North Carolina, where a jeweler told him it was gold. Upon his return home, Reed found gold to be so abundant along the creek that he formed the first gold mining company in North America. The entire surface along the creek for almost a mile was rich in gold.

Operations at the Reed mine were confined to placer mining until about 1831 when gold was found to exist in quartz veins embedded in hard, black slate.

In his article, "Famous Gold Nuggets of the World," Thomas Hurley says the Reed mine holds the world's record for the greatest production of gold nuggets as to size, value, and quantity. In all, nuggets weighing a total of 153 pounds and ranging in weight from 28 pounds down to 1¾ pounds were found.

About 1829, a group of local citizens organized the Cabarrus Gold Mining Company and mined a gold-quartz vein called the Vanderburg. In 1863, it was bought by the Phoenix Gold Mining Company for $265,000. A shaft was sunk along a vein averaging 30 inches in width to a depth of 485 feet. Before operations ceased in 1889, about 500 men were employed.

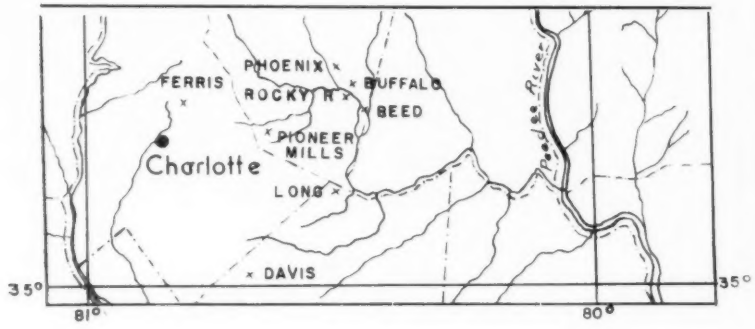
There were numerous other mines in the Cabarrus gold district, but they were smaller than the Reed and Phoenix mines. Some were the Rocky R., the Buffalo, the Long, the Davis and the Pioneer Mills.

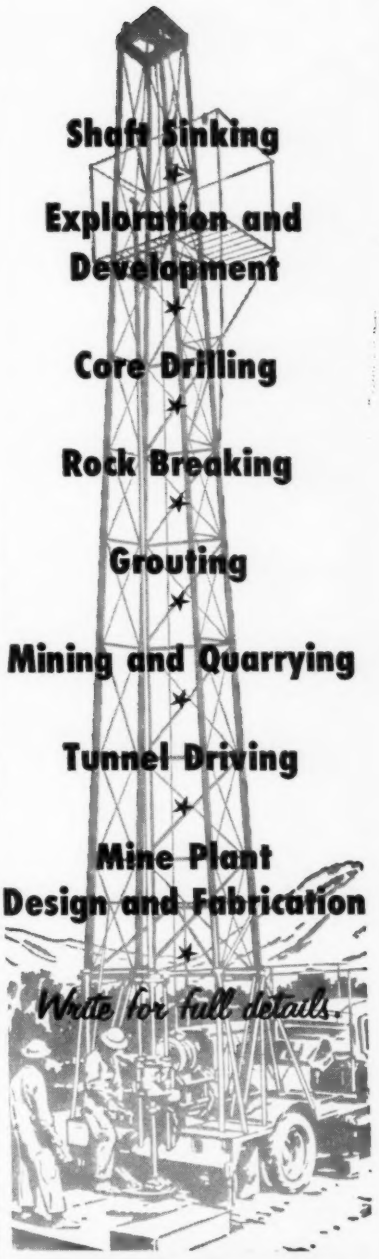
Most of these were in operation for a number of years prior to the War Between the States. Some were closed soon after discovery of gold in California when many of the most experienced miners left to go west. The remaining mines were closed as a result of the Civil War. Only the Phoenix reopened to operate until about 1889. There has been little prospecting in this district since that time.

The Cabarrus district, located as it is in the Piedmont Plateau of North Carolina, is in an area of little relief and extensive soil cover. The rock is deeply decayed—often to a depth of 100 feet, thus rock exposures are by no means plentiful. They are largely confined to the stream beds and the steeper hill slopes.

Most of the vein deposits occur in the "slate" beds that are prevalent through the area. These "slate" beds seem to represent a sedimentary series of shales with which volcanic flows, breccias, and tuffs are interbedded. Near the contact with the igneous rocks to the west, the series is closely folded and highly schistose. Toward the southeast, the effects of this intense metamorphism gradually dies out,the schistosity almost wholly disappears, and the rocks present only such structure as moderately close folds and joints.

It would certainly be remarkable if all the existing gold deposits had been found in this soil-encrusted district by the primitive prospecting methods in use 150 years ago.





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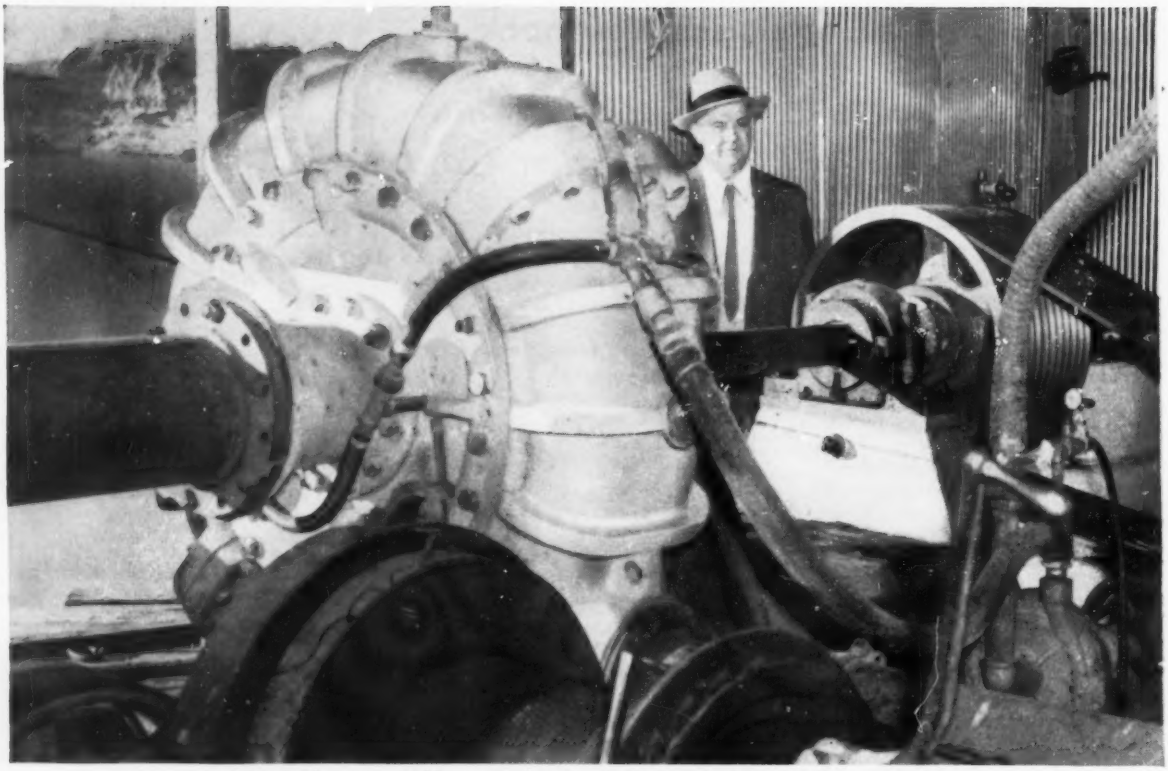


This dredge, operated by a prominent sand and gravel producer in Kansas, is equipped with a highly successful Thomas Ni-Hard pump installation.

Dredgers report Ni-Hard alloy pumps outwear others 4 to 6 times

From state after state come reports of the extraordinary service life of Thomas Ni-Hard pumps, made by Thomas Foundries, Inc., Birmingham, Alabama.

A West Virginia sand and gravel producer, for example, reports, "Since 1953, we have used only two Ni-Hard shell liners . . ."

A New Jersey company formerly replaced parts every 2 to 3 weeks . . . now says, "Today, we get approximately a year's service . . . a lifesaver."

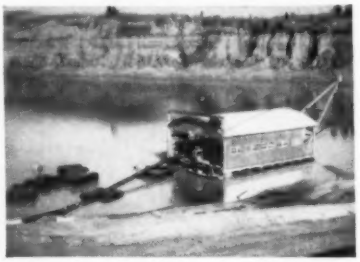
From Nebraska: – ". . . after almost two years of pumping has required no repairs, major or minor."

From Arkansas: – ". . . by far the most efficient and economical pump we have ever used, our 40-year records prove."

From these reports, it's easy to see that *longer pump life means lower operating costs!*

And a large part of the credit for the outstanding durability of Thomas Pumps goes to Ni-Hard* nickel-chromium cast iron.

This alloy is the most abrasion resistant of all commonly used cast materials, out-lasting many 4 to 6 times . . . regularly outwearing manganese steel in pump service.



What's more, Ni-Hard alloy has demonstrated remarkable impact resistance . . . being widely used for drop balls, crusher linings, and for many other severe applications. In impellers, casings, linings, and other parts for pumps, Ni-Hard alloy has virtually eliminated cracks or impact erosion caused by gravel and rocks.

If severe wear is running up your operating costs – it will pay you to find out what Ni-Hard alloy can do. Inco's booklet, "Engineering Properties and Applications of Ni-Hard" gives you essential details, and Inco's "Ni-Hard Buyers' Guide" lists authorized producers throughout the country. Write us for your free copy.

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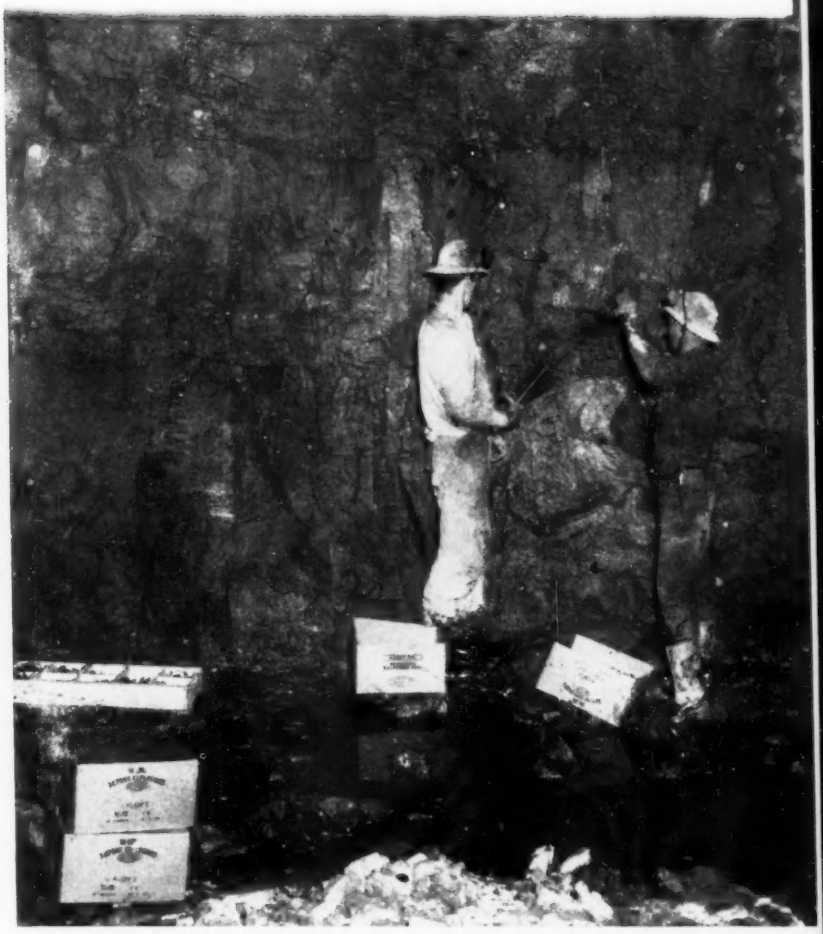

RESULTS of a typical blast with Du Pont HI-CAP 3 at this Moab, Utah, uranium mine.

LOADING DU PONT HI-CAP 3 (1¼" x 16") at Utex Exploration Company's uranium mine at Moab.

How Du Pont HI-CAP® cuts blasting costs at the Utex Exploration Company's MiVida mine

When Du Pont HI-CAP came on the market in the new, small-diameter sizes, Utex Exploration Company started using it in their uranium mine at Moab, Utah.

They find they sacrifice nothing in quality when they use this low-priced explosive. The grade they use—HI-CAP 3, 1¼" x 16" size—gives excellent fragmentation and good fumes.

Grade	Stick Count*	Water Resistance
HI-CAP 1	120	Good
HI-CAP 2	135	Fair
HI-CAP 3	150	None

*1 ¼" x 8" cartridges per 50 lbs.

You can cut your blasting costs appreciably in underground work with these new grades of small-diameter HI-CAP. The price is low—and the versatility of the complete line lets you use it in all types of shooting and under all but the most severe conditions.

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WHAT'S GOING ON IN MINING

Asarco Buys Copper Canyon Mines-Mill in Nevada

American Smelting and Refining Company has purchased the properties of Copper Canyon Mining Company, southwest of Battle Mountain in Lander County, Nevada. Sale price has not been disclosed. The transaction was made through the Small Business Administration, which held a public auction to recover money owed to the Reconstruction Finance Corporation.

Asarco acquired all of the claims and mill sites, a 350-ton-per-day differential flotation mill, power plant, mine camp, and buildings shown in accompanying picture. In addition, Asarco also acquired claims at Copper Basin, about eight miles northeast of Copper Canyon.

The area had first been developed in 1866. Between 1870 and 1880, the Battle Mountain Mining Company shipped over 40,000 tons of copper ore to Swansea, Wales. After that, the property was worked intermittently by various groups. In 1941, the International Smelting and Refining Company (Anaconda) took over the mine on a leasing basis of repayment of mill construction costs to be followed by a division of net proceeds. The lease was terminated in 1945. At that time, it was announced that the mine, although opened originally as a copper producer, was now principally a gold producer, and the gold content of the ore was increasing with depth.

Copper Canyon Mining Company resumed operation of the mine. Lead-zinc-silver ore became important. Then in 1952, the price of base metals dropped too much, and the firm curtailed operations. A newly formed Battle Mountain Copper Company was formed in 1955 to work the mine. An RFC loan was obtained, but the company went broke.

Asarco officials report that they plan an active campaign of geological and geophysical exploration work to determine whether a profitable mining operation can now be undertaken.

Arizona Mill To Recover Iron from Copper Slag

Arizona's first integrated steel plant is planned for the abandoned town of Clarkdale, once a copper operation of the Phelps Dodge Corporation. Webb & Knapp Inc. has formed Webb & Knapp Strategic Corporation to construct and operate a $15,000,000 steel plant which will recover iron from the waste slag of the old copper smelter and convert it into steel.

Strategic Materials Corporation will have a 15 percent interest in the new firm because the plant will use the Strategic-Udy process developed by Strategic Materials. Large-scale tests were made of the Clarkdale slag at the Niagara Falls, Ontario plant of subsidiary Strategic-Udy Metallurgical and Chemical Processes Ltd. The Clarkdale slag was found to contain about 33 percent iron, 0.5 percent copper, and 2 percent zinc. The tests recovered most of the copper and zinc as byproducts, and produced, through refining, quality steel of controllable grades. W&K Strategic will have world-wide exclusive rights to the use of the process on copper slags.

The Clarkdale plant will have an initial capacity of 500 tons of steel per day. This can be expanded to 1,000 tons if market demands warrant. It will roll reinforcing rods and other "merchant mill" products. A plant will also be constructed to produce insulation and lightweight aggregates for concrete building products from the controlled slag residue.

Zeckendorf Steel Company, a subsidiary of W&K Strategic, will operate the Clarkdale plant. It will lease the Clarkdale site, and buy the slag from Webb & Knapp. The slag pile now amounts to about 30,000,000 tons. W&K has also contracted to purchase 40,000,000 tons of slag from the Anaconda Company operations at Anaconda, Montana. W&K Strategic may erect another steel plant at Anaconda which could use hot slag directly from the smelter.

Koppers Company of Pittsburgh, Pennsylvania is affiliated in the venture and will build the Arizona plant. It will use the abandoned copper smelter buildings and facilities which cover around 1,200 acres.

Clarkdale was built in 1914-1915 as a model company town. After PD closed the smelter in 1950, it was sold to W. L. Allison of Phoenix, head of Alliston Steel Manufacturing Company. In 1954, Earle P. Halliburton purchased it.

WKE Designs Asarco's New Arizona Copper Mill

Design and engineering of the 15,000-ton-per-day copper flotation concentrator for American Smelting and Refining Company's Mission Project near Tucson, Arizona will be handled by Western-Knapp Engineering Company of San Francisco. The firm was awarded the contract for the copper concentrator which is a major construction item in the $43,500,000 project.

The mill will be one of the most efficient of its kind, incorporating the newest metallurgical techniques, and using many automatic measuring and control devices. It is estimated that the annual throughput of the mill will be 5,400,000 tons, producing about 45,000 tons of copper.

The mill site has been termed "ideal" because it includes a level site, adequate power, enough water, easy availability of labor, and good roads. Metallurgically, the ore is "simple to treat"; however, it varies greatly from very soft to very hard ore, depending on location in the pit. Grade will also vary widely in the pit, so it will be a mining problem to maintain both tonnage and grade.

Three crushing stages are assured—a primary gyratory, followed by two fine cone-type crushers. There will be two-stage grinding for flexibility and low cost. Initial grinding will be in rod mills, followed by ball mills. All classification will be made by cyclones. Molybdenite is reported in the ore, but initial plans do not call for molybdenite recovery.

E. H. Scheick is project engineer for Asarco, and J. H. Cheavens has been named project manager for Western-Knapp. Engineering has started, and completion of the total project is scheduled within two and one-half years.

ARIZONA

The old **Johnson** mine camp near Willcox, Arizona is active again after a two-year shutdown. **McFarland and Hullinger,** a Utah mining concern, has leased the property from **Coronado Copper and Zinc Company.** Bill Stoffers, mine manager, reports that two cars of copper ore per day are shipped to McFarland and Hullinger's flotation mill at Sahuarita, Arizona. Maximum production is expected to provide about three cars per day. A 30-man crew is working one shift per day at the Moore shaft. Johnson was once a boom town when copper was discovered there in 1881, before the **Southern Pacific Railroad** was built through southeastern Arizona. A smelter was erected at Russelville in 1882, where there was abundant water. The deposit has been worked intermittently, production peaks coinciding with high copper prices and stopping entirely during price slumps. In 1913, shortly after the main ore body was discovered, the mine had 1,000 employes. Coronado Copper and Zinc has owned the property since 1942.

Fabled Tombstone, Arizona, where silver mines have long been dormant because of water troubles, will soon echo to the sound of prospectors. Frank Frankovich, who has leased the **Vizina** mining claim from **Newmont Exploration, Ltd.,** has been given permission to diamond drill through several streets of the town, on 50-foot centers. Mr. Frankovich says that geology of the area leads him to believe that the area offers good prospecting because of its location adjacent to the old **Million Dollar** stope.

CALIFORNIA

New Idria Mining and Chemical Company is said to be considering reopening the **Strawberry** tungsten mine a few miles southeast of Yosemite National Park in California. Improved prices would be the reason. Since the mine is located at 7,000 feet, it could not be opened until the spring.

For the past 30 days, the **Bureau of Land Management** of the **U.S. Department of the Interior** has been publishing notice of proposed withdrawal of about 35,800 acres of **Death Valley National Monument** from entry under mining laws. The withdrawal was requested by the **National Park Service** in order "to provide proper administration and protection of scenic, historic, and scientific areas in the Monument which could be destroyed if entry under mining laws were permitted". If circumstances warrant it, a public hearing would be held.

Clute Corporation of Littleton, Colorado reports that its asbestos mill near Napa, California is now in full operation. A survey of the holding in this area indicated ore reserves of 1,795,600 tons, according to Eugene Carter, geological engineer. The firm also has a mica mine and mill in New Mexico, and manufactures machinery which uses air to refine mica, asbestos, and similar materials.

Jefferson Lake Sulphur Company has been exploring an asbestos property in Calaveras County, California. There are indications of commercial quantities of ore, and further data is being gathered to make a final determination.

W. R. Noack is planning to reopen the old **Loretto** copper mine 22 miles east of Big Pine, Inyo County, California. He proposes to drive a new adit so that ore will not have to be hoisted. A large tonnage of oxidized (malachite and chryscholla) copper with gold and silver values has been developed on several levels. If a six-to-one concentration ratio can be achieved, a 150- to 200-ton-per-day flotation mill will be built near Big Pine where water is available. Ore would be trucked to mill.

Kaiser Engineers of Oakland, California has received an AEC contract for the study of the potential use of nuclear power at remote military installations. Estimated cost of the project is $515,000. The company will submit results to the Commission by February 1, 1960.

The Port of Stockton, California, set a new ore loading record recently when it loaded 21,127 tons of iron ore and magnesite in less than 24 hours. The ore was from mines in California and Nevada. The **Mokyo Mau** of Japan took on 10,724 tons and **Mitta Maru** loaded 10,403 tons, simultaneously.

A series of courses covering preventive maintenance, trouble-shooting, and repair of major components used on Euclid earthmoving equipment is being offered by **Euclid's Service Training Department.** The school will be held at the **General Motors Training Center,** 1444 First Avenue, San Leandro, California, from November 16 through December 18, and is open to all Euclid owners, operators, and service personnel from the San Francisco area. Contact your local Euclid dealer for further information.

NEVADA

Beryllium Resources Inc., formed by **Hidden Splendor Mining Company** to acquire control of **Mt. Wheeler Mines** at Ely, Nevada, has reached an agreement with **Brush Beryllium Corporation.** The arrangement provides for mutual exchange of information and assistance, and places Bengt R.F. Kjellgren, president of Brush, on Beryllium Resources' board of directors. The Mt. Wheeler property is a large low-grade disseminated beryllium deposit (see MINING WORLD, October 1959, page 7).

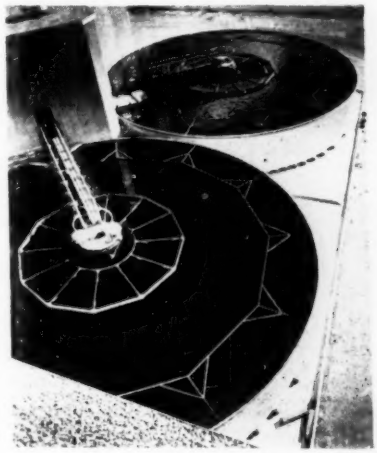
The Reno, Nevada laboratories of the **U.S. Bureau of Mines** have developed a new and simpler method for producing commercial-grade tungsten and molybdenum powders suitable for use in alloys (especially steels). Known as the fused-salt-bath electrolysis, the method has been tested successfully on the most common tungsten mineral, scheelite, which usually contains the undesirable molybdenum mineral, powellite, as an impurity. The metallurgists were able in one operation to produce molybdenum of 98 percent purity and tungsten of better than 99 percent purity.

Goldfield Consolidated Mines Company and **Apex Uranium Inc.** have signed an agreement covering development of Apex's mine near Austin, Nevada. Goldfield is drilling while Apex is shipping ore. After final arrangements have been completed with the AEC for a mill, Apex will stop mining and Goldfield will take over.

Yuba Consolidated Industries Inc.'s Mining Division has received six-month entry permits from Mineral County Nevada to prospect tax delinquent patented claims near Rawhide. The firm will prospect for gold on these 20-acre claims, and is permitted to pay the back taxes at the end of the permit period if the properties are desirable.

Froth Baffles Break Up Foam at Uranium Mill

Two 75-foot-diameter, Dorr Type S-120 thickeners handle mill slurries at Homestake-New Mexico Partners' uranium processing mill near Grants, New Mexico. The foreground unit clarifies pregnant liquor from the primary leaching and filtering system. The second unit thickens grinding circuit slurry. The unusual structure at surface of both thickeners consists of special 30-foot-diameter froth baffles which break up foam accumulation, and a perimeter mounted baffle arrangement installed to control wave action caused by the high winds common to that area. Clarified overflow from the foreground unit goes to the precipitation step, while overflow from the slurry thickener returns to the grinding circuit for reuse. Thickened pregnant liquor underflow goes to the mill's carbonate leach circuit. The Grants mill went into operation early in 1958, with an initial 750-tons-per-day capacity. Concentrates are purchased by the Atomic Energy Commission.



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Thermocoal Conveyor Belting

The test? U. S. Bureau of Mines Flame Test, designation U. S. B. M. 28-11.

The material? Thermoid-Quaker *Thermocoal* Conveyor Belting with fire-resistant, flame-retardant neoprene cover and cotton-nylon reinforcement.

The requirements? No more than one minute of burning after the belt is ignited.

The results? The flame went out *immediately* on *Thermocoal* belting. Afterglow disappeared in *one-third* the permitted time.

Underground safety is just one of the features of *Thermocoal* conveyor belting U. S. B. M. 28-11. It is light in weight and extremely flexible, yet tough enough to take shock, impact, and the abrasive wear of heavy, jagged loads.

Get safety, service, and strength for your mine's belting. Call your Thermoid industrial distributor for full information, and for valuable assistance on all problems involving industrial rubber products. Or write today to *Thermoid Division, H. K. Porter Company, Inc., Tacony and Comly Streets, Philadelphia 24, Pa.*

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SOUTHWEST

The **Fred Harvey Associates** of Tonopah, Nevada have spent about $100,000 in exploration of Queen's Canyon in the White Mountain Range of Nevada and are now reportedly planning to install a 25-ton smelter. The ore carries values in gold, silver, and lead. The company is presently shipping barite to Los Angeles from its other mines in Nevada.

NEW MEXICO

Rare Metals Corporation of America has begun shipments of uranium ore from its **San Mateo** ore body in the Ambrosia Lake district of New Mexico. The mine should be producing at a rate of 400 tons per day by the end of the year. Reserves are estimated at more than 1,000,000 tons averaging about 0.2 percent U_3O_8. The firm recently secured two leases totaling 320 acres on Navajo Indian land in McKinley County, and plans to explore for uranium, there next year.

The **Entrada Corporation's Mary No. 1** mine is now producing 500 tons of uranium ore per day and operations will be stepped up to 1,200 tons daily. The property is located in the northwest quarter of Sec. 11, T. 14, N., R. 10 W. in the Ambrosia Lake district of New Mexico. It is operated by **Boyles Brothers Drilling Company** under a cooperative agreement. The mine was developed at a cost of $600,000, and has two stations. Two additional levels will be cut in the next few months. Ore is averaging slightly higher than 0.20 percent. U_3O_8 reserves are estimated at 1,680,000 tons.

The **Atomic Energy Commission** recently computed the reserves of the **Homestake-Sapin Partners**, in both indicated and inferred ore, as 6,688,000 tons of approximately 0.24 percent U_3O_8 totalling 31,620,000 pounds of U_3O_8, with a gross value of $252,966,400. The partnership is planning to establish a research division during this fiscal year to study all possibilities of producing products beyond yellow cake. The partnership is composed of **Sabre Pinon Corporation** and **Homestake Mining Company**. Three mines are held by the partnership—**Sections 15, 23,** and **25.** The Section 15 mine is now producing satisfactorily; the Section 23 and Section 25 mines are still classified as in the development stage. Section 23 will be mining within a few months, but Section 25 will probably not be out of the development stage during fiscal 1960.

One more decision rendered during the case of **Rio de Oro Uranium Mines Inc.** and **United Western Minerals Company** vs. **Homestake Mining Company** has stated that Homestake need not be compelled to return its profits from the **Homestake-Sapin** partnership to the **Homestake-New Mexico Partners** as contended by Rio de Oro. In previous decisions, Homestake was found liable for damages and was restrained from processing custom ore from the Rio de Oro mine. (See Mining World, June 1959, page 75, and September 1959, page 97.)

precipitates—NORTHWEST

Program Set for Northwest Meeting

Two of the Pacific Northwest's biggest metal mining operations will be described at the Northwest Mining Association's 65th annual convention in Spokane, Washington, December 4 and 5. Sessions will be held at the Davenport Hotel.

E. I. Renouard, vice president in charge of western operations for the Anaconda Company at Butte, Montana, will report on "The Butte District." He is scheduled to speak at the first general session on December 4.

Operations of Consolidated Mining and Smelting Company of Canada will be described by R. R. McNaughton, Trail, British Columbia, chief of Cominco's division of metallurgy. Mr. McNaughton will address a luncheon meeting on December 5 which will be sponsored by the local chapter of the American Institute of Mining, Metallurgical and Petroleum Engineers.

John D. Bradley, San Francisco, president of the Bunker Hill Company, at Kellogg, Idaho, tentatively is scheduled to address the opening session. Howard I. Young St. Louis, Mo., president of American Zinc, Lead and Smelting company, will report to the opening session on the company's Tennessee zinc deposits.

Other convention speakers will include Bruce M. Gonser, technical director of the Battelle Memorial Institute, Columbus, Ohio, "New Uses for Old Metals"; James Quigley, Centennial Development Company, Eureka, Utah, "Circular Shafts"; John W. Currie, resident manager for the Metaline, Washington operations of American Zinc, Lead and Smelting Company, "Innovations at Metaline."

John R. McWilliams, United States Bureau of Mines, Spokane, "Rock Pressures in Deep Mines"; Robert Davis, Hecla Mining Company, Wallace "Placement of the Concrete Plug Between the Hecla and Star Mines"; Clifton W. Livingston, president of Barodynamics, Inc., Georgetown, Colorado, "Applications of Explosives Research to Blasting in Mines and Quarries."

A session on Northwest iron ore resources will offer H. Dewayne Kreager, director of the Washington State Department of Conservation and Industrial Development, Olympia, "Iron Resources in Washington"; George Fagen, Pacific Northwest Alloys, Spokane, "Ferroalloys—Specifications and Usage", and a talk by a Bureau of Mines official on "Recent Development on Reduction of Iron."

A geology session will include a talk by F. W. Sainsbury of the United States Geological Survey, Menlo Park, Calif., "Lost River Tin Deposit, Alaska," and a report by a Hecla Mining Company geologist on "The Origin of the Coeur d'Alene Ore Deposits." A milling and metallurgy session will be presided over by George Dunn, superintendent of the Bunker Hill smelter at Kellogg, Idaho.

Frank N. Marr, a Spokane mining man and former NMA president, is convention chairman; E. C. Stephens, geologist in charge of the Anaconda Company's Northwest exploration office at Spokane, is assistant general chairman. Frank C. Armstrong of the United States Geological Survey's Spokane office is program chairman, and Hamilton Owen is in charge of registration.

Program committee members are A. E. Weissenborn, Verne E. Fryklund Jr., and W. D. Nesbitt, Spokane; George W. Dunn, Kellogg, Idaho; Henry L. Day and Rollin Farmin, Wallace, Idaho; and Charles Mitchell, Vancouver, B.C.

Other committee chairmen include Karl W. Jasper, E. K. Barnes, Wing G. Agnew, Carlos Milner, Fred J. Weiler, and David E. Watson.

Resolutions committee members are John Edgar, Sunshine Mining Company, Spokane, chairman; Ross D. Leisk, W. D. Farmin, R. M. Hardy Jr., C. E. Schwab, H. J. Hull, J. W. Currie, M. C. Brown, W. H. Love, J. C. Kieffer, L. M. Kinney, A. R. Patterson, P. E. Oscarson, R. H. McConnel, J. J. Crowhurst, Robert G. Dwyer, Eustace LeMaster, Harry G. Magnuson, and E. H. Lovitt.

Daybreak Uranium Upgrades Autunite

This experimental upgrader built by Daybreak Uranium, Inc., has washed 20 tons of 0.07 percent uranium oxide rock in an eight-hour period and recovered 10 tons of concentrate averaging 0.18 percent uranium oxide. Greenish-yellow autunite crystals are broken loose from mud-like conglomerate and from fractures in granite rocks by sprays of water. Crystals up to one-quarter inch in size pass through a vibrating screen. Larger massed crystals are picked off the screen by hand. Concentrate settles out on the ground down hill from the upgrader and is retrieved by a loading machine. Waste rock drops off the screen to one side of the upgrader and is bulldozed away. Very little uranium is lost. The operation is in Washington state's Mount Spokane district where Daybreak operates its open-pit mine on the Dahl lease. The concentrate is being mixed with some of the high-grade being mined from a newly drilled near-surface deposit and trucked to Dawn Mining Company's uranium processing plant at Ford, Washington. The upgrader was built by Earnier A. Collins, mine superintendent, who is shown above with his son, Donald.

ALASKA

Eight Japanese firms are reportedly interested in developing an Alaskan iron mine where exploration work has been going on for the past two years. The property is in the area of the Bradfield Canal North of Ketchikan. It was discovered by local Ketchikan prospectors who interested **Standard Slag Company** and **C. T. Takahasi and Company Ltd.** in the deposit. Edward Y. Osawa, president of Takahashi, an export-import firm, escorted a group of Japanese representatives around the site during the summer so that they might determine whether the property is worthy of a $5,000,000 to $8,000,000 investment.

The **JOT Mining Company** of Oklahoma City, Oklahoma, is mining uranium from the open pit of **Kendrick Bay Mining Company** this fall and winter. Shipments are being made to **Dawn Mining Company's** plant at Ford, Washington. Located on Bokan Mountain south of Ketchikan, the property is owned by Kendrick which is a subsidiary of **Climax Molybdenum Company**, in turn, a division of **American Metal Climax Inc.** Also part owners in the venture are Don Ross and Kelly Adams who discovered the property in 1955.

Four hundred feet of ice have been chipped from the main adit of the **Mikado** gold mine in the Chandalar district north of the Arctic Circle. About 300 feet of new drifting and raising had been completed by early October, and

Frank Birch and Bob Nusbaum, mining engineers who contracted to do the underground work, expect to complete their contract for this year sometime this month. The work is being done for **Little Squaw Mining Company** of Spokane, Washington.

IDAHO

At the **Conjecture** mine in Bonner County Idaho's Lakeview Mining District, the new 1,000-foot level drift on the Conjecture vein had been in silver-lead ore for more than 200 feet at last report. A raise to the 700-foot level was in good ore and a substantial ore body had been proved. **Federal Uranium Corporation** of Salt Lake City is developing the property under a profit-sharing agreement with **Conjecture Mines, Inc.** of Spokane, Wash.

The **Sunshine** mine in Shoshone County, Idaho's Coeur d'Alene Mining Region, largest silver mine in the United States, is being deepened 420 feet for a total depth of 4,420 feet. This will put the mine 1,720 feet below sea level and make it the deepest mine in the district. It will be some 300 feet deeper than the **Bunker Hill** and **Galena** mines. The deepening is being accomplished by means of a three-compartment offset winze nearly 5,000 feet east of the main Jewell shaft. Midway between the Syndicate and Chester faults, the shaft will open at additional depth the Polaris "08" and "09" veins and a branch of the Chester vein. The winze will go down from the present bottom 4,000-foot level and new working levels will be established at the 4,150 and 4,300 horizons.

Operations at the **Page** lead-zinc mine near Kellogg, Shoshone County, Idaho, were returned to a five-day week basis recently from the four-day week put into effect last spring because of low base metals prices. About 240 men are employed at the **American Smelting and Refining Company** operation. Ore concentrates produced at the Page and Asarco's **Galena** and **Jack Waite** operations in the same Coeur d'Alene Mining District were stockpiled at the properties during the strike of the International Union of Mine, Mill and Smelter Workers which closed the company's East Helena, Montana smelter.

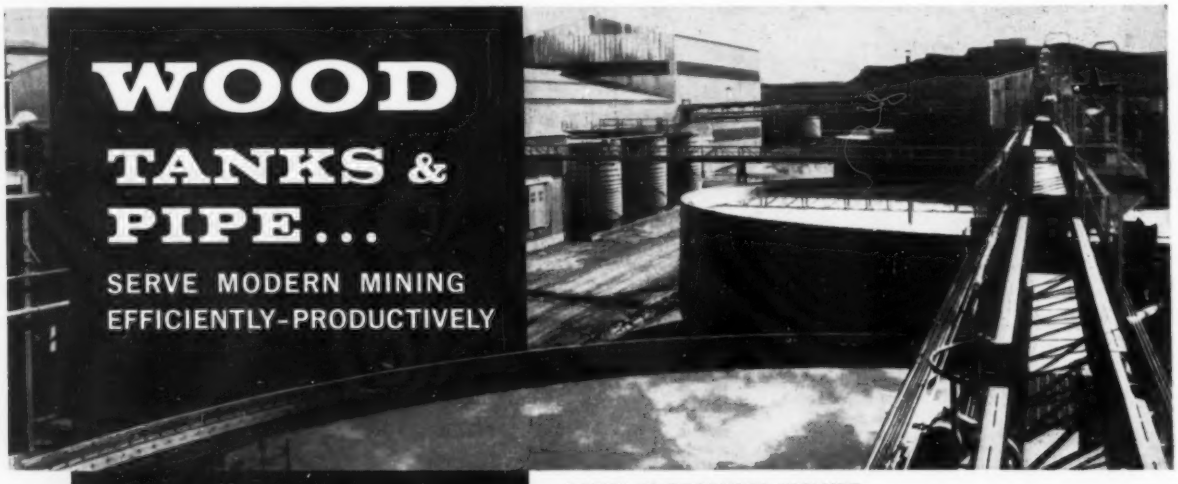
Detailed studies of the **Bunker Hill** and **Star** mines in the Coeur d'Alene mining region of Shoshone County, Idaho, are being made by W. E. (Tex) Romig, internationally known mine consulting engineer, to determine if costs can be lowered.

The **Hercules** mine of **Day Mines Inc.** has closed after a half century of production. All the material that will make ore at present lead-zinc prices has been mined out. The property had been reopened in 1947 and another ore body located in exploration from the 1,000 level. In recent months, 100 tons of ore a day have been produced but low base metal prices cannot carry this output.

MONTANA

A new 100-ton selective flotation concentrator has been put into operation near Libby, Lincoln County, Montana by **St. Paul Lead Company** of Kellogg, Idaho, and **Merger Mines Corporation** of Coeur d'Alene, Idaho. The mill started operations on jig tailings and ore from the **Snowshoe** mine jointly owned by the two firms, but will handle production of other area operators on a custom basis. The charge will be direct operating costs plus $1 per ton profit. Block leasers in the Snowshoe mine have opened a sizeable block of lead-zinc-silver-gold ore in a supposedly mined-out area. A 12,000-gallon water storage tank, 100-kw Diesel electric plant, and 10,000-gallon Diesel fuel tank have been installed and a new access road built to the crushing plant. A. L. Osborn is president of St. Paul Lead and E. C. Gerry is secretary of Merger.

Bear Creek Mining Company, Kennecott Copper Corporation's exploration subsidiary, is reported to have filed on 107 claims in the Philipsburg area of Montana. The property covers about 3,000 acres and is believed by local observers to contain copper.



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OREGON

A crusher, ball mill, amalgamation plates, table, and cyanide equipment have been installed at the **Humdinger** mine in Josephine County, Oregon by Earle Young and Walter Lonnon. At the nearby **Snow Bird** mine, George Slade has erected a small gold mill to handle raise ore.

Bert and Ernest McTimmonds of Grants Pass, and Russell Calhoun of Wilderville are putting up a small mill to recover free gold and concentrates at a new prospect near Canyon Peak, Curry County, Oregon.

Gold-bearing material discovered northeast of Tiller, Douglas County, Oregon is being tested in the old Waldo mill on French Flat by **Zinc Creek Mining Corporation.**

The **Bonanza** quicksilver mine and furnace in Douglas County, Oregon is operating at capacity and development work is underway on the 1,400-foot level. Tom W. Bidwell Jr. is mine superintendent.

Albert Schiemeister and Frank Melvin and associates of Grants Pass, Oregon have leased the **Gray** cinnabar property in Lake County's Coyote Hills.

At the **Buffalo** mine at Granite, Grant County, Oregon's principal lode gold producer, **Boaz Mining Company** is driving a new 1,400-foot working adit to gain 230 feet of additional depth. J. P. Jackson is manager of the firm which has headquarters in Seattle, Washington.

Diamond drilling is under way at the **Phoenix** mine near Greenhorn in Grant County, Oregon. Lawrence Banta is directing the work for **Gold Star Mining and Milling Company** of Baker.

A skid-mounted washing plant of 75 cubic yards per day capacity has been set up by Frank Mayo of Sumpter on leased placer claims on Burnt River above Whitney, Oregon.

Oil-Minerals Operation, Inc. of Tulsa, Oklahoma has a dragline, washing trommel operation at the **Suksdorf** placer claims in Baker County, Oregon's Mormon Basin District. Water is pumped from the old **Humboldt** mine. Calvin Suksdorf of Baker is in charge.

WASHINGTON

Diamond drilling done by **Goldfield Consolidated Mines Company** at the **Anderson** zinc-lead property in Stevens County, Washington's Northport Mining District indicate an extension of the present open-pit ore body or a new ore body. More work remains to be done to determine the commercial importance of the showings but consideration is being given to reopening mining operations if base metal prices warrant. The Anderson was shut down in 1951. Willis A. Swan, San Francisco, is executive vice president of Goldfield Consolidated.

American Eagle Mining Company is developing a promising surface exposure of high-grade lead-silver-copper stringers in a big quartz vein. A four-man crew sunk a 65-foot shaft on the vein before work was suspended for the winter. The property is 14 miles south of Kettle Falls, Stevens County. Ronald E. Madden of Spokane is president, and Ward Shafer is scretary-treasurer.

Hunting Geophysical Services of New York was awarded a $40,000 contract for an aerial survey of certain areas of the State of Washington. The search for iron ore deposits centered chiefly in northern Ferry and Okanogan counties.

Ideal Cement Company is planning to quarry limestone at Lime Point, Washington, on the Snake River, for a $14,000,000 cement plant which it will build next year at Clarkston, Washington. The plant will have a capacity of 1,500,000 barels of cement annually.

Elmer L. Smith of Grand Junction, Colorado has been doing exploratory drilling at the **Nancy Creek** uranium properties of **Triton Mining Company** in Ferry County, Washington, which he holds under lease. He is primarily interested in the rare-earth content and may put in an upgrading plant.

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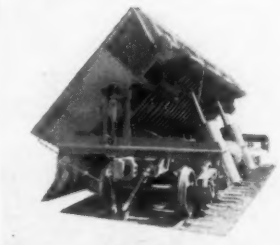

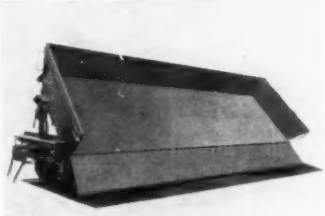

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While working a 750' shaft-deepening project from the 2300 to 3050 foot level, the Lucky Friday Mine ran into a dewatering problem which required pumping out an average of 150 to 175 GPM. At the start of sinking operations, air pumps were used, but because of periodic extra volume water seepage and excessive repair and maintenance costs, the air pumps were abandoned in favor of Flygt Model B-80L Submersible Electric Pumps.

In the pumping cycle, a Flygt Pump was lowered to the shaft bottom as soon after each blast as possible, and the water was lifted to relay pumps at a higher level, with heads up to 80 feet. The Mine Engineer, in a paper on the operation delivered before the Northwest Mining Convention, said of the Flygt pumping method: "Although the initial cost seemed high at first, the absence of expensive upkeep and the efficient pumping performance justified the investment. The quiet operation of the Flygt was a decided relief after listening to the siren-like air pumps. The Flygt Electric Pump was a distinct improvement over any type of air pump where large volumes of water had to be moved from the shaft bottom. It was low in upkeep cost and its unusual flexibility made it a definite advantage."

Since shaft sinking was completed, two Flygt Model B-80L Pumps now have become a part of the Lucky Friday's permanent mine pumping installation. In service since October 1956, they still are performing with a maximum of efficiency and a minimum of upkeep.

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COLORADO

Mile High Oil Company has changed its name to **U.S. Beryllium Company, Inc.** because it is more appropriate for the company's operations. The firm operates the **Boomer** beryllium mine on Badger Flats in Park County, Colorado, and also has a 45 percent interest in the **Blue Jay** mine and four claims adjoining the Boomer. Recently the firm added another 21 claims in the area to its potential reserves. Shipments are made to the government stockpile, and negotiations reportedly are underway for a mill contract.

The **Mollie Kathleen** mine, at Cripple Creek, Colorado, operated by lessees Ferguson, King, and Kumetat, is yielding gold ore on the 1,000-foot level. This shaft was operated as a tourist attraction during the past 10 summers. The hoist and compressor house, destroyed by fire last spring, has been replaced by a fireproof building.

Golden Cycle Corporation at Cripple Creek, Colorado is preparing for increased operation at its Ajax shaft, where ore is being mined at 3,100 feet, and where recent winze work below that level has disclosed ore. The old headframe has been replaced by a steel frame some 25 feet higher, affording additional bin room. This headframe was moved from the company's abandoned coal mine near Colorado Springs. A night shift has been put to work in the shaft and tonnage is to be increased.

The new Tenmile Tailing Pond of **Climax Molybdenum Company** has been just about completed at its location near Kokomo, Colorado. The Mill Department has been depositing tailing in the pond since early in July at a rate of about 10,000 tons daily. It is hoped that by 1965 the pond will be sufficiently prepared to receive the entire tailing flow from the Climax mills. The re-claimed water from this pond is returned to the Robinson Lake reservoir through the recently constructed Tenmile Tunnel and No. 2 Canal. A new pumping station is the other large item in this project.

UTAH

Minerals Engineering Company has purchased the 50 percent interest in **Salt Lake Tungsten Company** held by **Sylvania Electric Products Corporation,** making Minerals Engineering sole owner of the refinery. The firm plans to reactivate its refining operations in Salt Lake City, Utah at the end of the steel strike. A high purity paratungstate is to be produced instead of an average grade product. The program calls for modernization of the refinery and rehabilitation of the tungsten mill and open-pit mine near Dillon, Montana.

San Francisco Chemical Company, jointly owned by **Stauffer Chemical Company** and **Mountain Copper Company Ltd.,** has exercised its option to purchase the 15,000-acre phosphate deposit, 15 miles north of Vernal, Utah. The deposit is owned by **Humphreys Phosphate Company** and has been under lease and option to San Francisco for some time. Estimated reserves are set at 700,000,000 tons of rock averaging 21 per cent P_2O_5. Tentative plans call for open-pit mine preparation and construction of beneficiation plant at the mine by San Francisco Chemical; erection of a 35,000-kw elemental phosphorus furnace by Stauffer, with a second furnace at a later date; and construction of a rail spur for ore transportation. The furnaces depend upon outcome of the proposed hydroelectric power plant project at Flaming Gorge Dam. (Stauffer would have to bid for the power.) A merger with **Victor Chemical Works,** under discussion at this writing, would provide for the furnace construction since Victor operates an elemental plant at Silver Bow, Montana, and is constructing another in Tennessee.

Amalgamated Chemical Company has been formed in Utah. The firm holds potash permits on 50,000 acres in southwestern Utah and southwestern Colorado. N. G. Morgan, Sr. is president. Vice presidents include Louis Buchman, and Guy P. Backman. Virgil V. Peterson is secretary, and Orval W. Adams is treasurer.

WYOMING

Over 9,600,000 cubic yards of waste overburden have been removed since mining operations were started by **Lucky Mc Uranium Corporation** in the Gas Hills area of Wyoming, with 5,600,000 cubic yards stripped in the past year ended June 30, 1959. The stripping ratio has averaged 20 cubic yards of waste for each ton of ore mined. During the past year the stripping ratio was 17 to 1, and this year is expected to be 23 to 1. Since start of operations, 481,099 tons of ore have been mined and delivered to the mill. Of this, 339,236 tons containing 5.50 pounds or uranium oxide per ton were mined in the past year. About 450,000 feet of development drilling was done during the last year on the main Lucky Mc claims in order to develop additional ore reserves, provide information for pit design and layout, and to assist in ore mining control. Reserves were increased substantially because of this work, and average grade of Lucky Mc reserves is now in excess of 0.30 percent U_3O_8. The possible merger of Lucky Mc with **Utah Construction and Mining Company** is under discussion.

Utah Iron Mine Generates Own Power

Columbia Iron Mining Company, a subsidiary of U.S. Steel Corporation, generates its own electric power for open-pit mining at the Iron Mountain and Desert Mound mines, 20 miles west of Cedar City, Utah. Three Worthington Diesel engines, each developing 710 kw of full loading rating continuously, operate at an elevation of 6,500 feet above sea level. The picture shows how the power is used in the pit, with electric cable running along the bench (center) to power churn drills and shovel. Every two years the engines are scheduled for a general overhaul if the condition of the engine requires this work. The last general overhaul was in October 1956 and the next one is scheduled for this fall. The top compression piston rings were replaced during the last overhaul. Since the plant was started 10 years ago, only one liner has had to be replaced. The key to this reliable performance is the comprehensive maintenance schedule maintained by J. R. Strate, maintenance superintendent at the power plant. Every month the fuel pumps and injectors are inspected and serviced. The bearings are checked when a piston is removed and leads are taken on all bearings at the time of a general overhaul. At least once a month lubricating oil samples are taken and sent to a commercial laboratory for analysis. In the course of daily operation, power plant operators make careful hourly checks of each engine.

COMING CONVENTIONS

October 28 through 31. INTERNATIONAL MINING DAYS and the annual meeting of the NEW MEXICO MINING ASSOCIATION, El Paso, Texas.

November 9 through 12. Annual meeting SOCIETY OF EXPLORATION GEOPHYSICISTS, Biltmore Hotel, Los Angeles, California.

November 19 and 20. Missouri School of Mines Annual SYMPOSIUM ON MINING RESEARCH. Rolla, Missouri.

December 4 and 5. Annual Convention of the NORTHWEST MINING ASSOCIATION, Davenport Hotel, Spokane, Washington.

February 14 through 18, 1960. Annual meeting of the AMERICAN INSTITUTE OF MINING, METALLURGY, AND PETROLEUM ENGINEERS. Statler Hotel, New York, New York.

March 17, 18, and 19, 1960. NATIONAL WESTERN MINING CONFERENCE, sponsored by the Colorado Mining Association and affiliated groups. Denver Hilton Hotel.

STATEMENT OF OWNERSHIP

Statement required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933, and July 2, 1946 (Title 39, United States Code, Section 233) showing the ownership, management, and circulation of Mining World, published monthly except in April when publication is semi-monthly at Bristol, Connecticut, for October 1, 1959.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publishers: Wm. B. Freeman, L. K. Smith, Miller Freeman, Jr., 500 Howard Street, San Francisco 5, California; Editor: George O. Argall, Jr., 500 Howard Street, San Francisco 5, California; Managing Editor, none; General Manager: M. F. Holsinger, 500 Howard Street, San Francisco 5, California; Business Manager, none.

2. The owner is: American Trade Journals, Inc., 500 Howard Street, San Francisco 5, California; Miller Freeman Publications, Incorporated, 500 Howard Street, San Francisco 5, California; Wm. B. Freeman, Miller Freeman, Jr., 500 Howard Street, San Francisco 5, California; W. E. Crosby, 71 Columbia Street, Seattle 4, Washington.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: NONE.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. Wm. B. Freeman, Publisher. Sworn to and subscribed before me this 1st day of October, 1959. (Seal) Barbara M. Hampson, Notary of the Public, San Francisco, California. (My commission expires February 18, 1962.)

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CENTRAL AND EASTERN

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American Zinc, Lead & Smelting Company is reopening its zinc mines and milling facilities in New Diggings, Wisconsin which had been closed since 1957 because of the low price for slab zinc. Starting with 1960, the property's output is expected to be an annual rate of from 12,000 to 15,000 tons. Until this action, the **Eagle Picher Company** mine at Shullsburg has been the only mining company producing in the area, which was once the scene of widespread lead and zinc mining operations.

Mallinckrodt Nuclear Corporation has completed shipment of almost 20,000 pounds of enriched uranium dioxide powder for the first major privately financed U.S. power reactor now under construction by the **Commonwealth Edison Company** at Dresden, Illinois. The uranium dioxide went to the **General Electric Company** plant at San Jose, California where it was pelletized and canned in zirconium tubes for use as fuel for the reactor. Mallinckrodt was the first U.S. firm to begin commercial processing of enriched uranium hexafluoride to uranium materials suitable for use as nuclear fuels. Its operations are conducted in a plant at Hematite, Missouri.

United States Glass and Chemical Corporation of Tiffin, Ohio is building a $500,000 barite and gravel mill at Dierks, Arkansas. **O. W. Walvoord, Inc.** has the contract for the work. An estimated initial output is 35,000 tons of barite annually and 250,000 tons of gravel. Robert B. McElwaine of Little Rock, consulting geologist, will supervise the operation as director of the firm's new barite mining division.

Athletic Mining & Smelting Company has made a further reduction in slab zinc output produced at its retort smelter at Fort Smith, Arkansas. The operation had been running at only 60 percent of capacity since June 1957; with a 33 1/3 percent reduction, it will now be operating at only 40 percent capacity. Since the smelter had been producing slab zinc at a rate of about 1,500 tons per month, this will be reduced to 1,000 tons. The firm blames the quota system for a drastic reduction in supplies of zinc concentrates from Mexico.

Metallurgists at the **U.S. Bureau of Mines** laboratories in Rolla, Missouri have produced high-purity tungsten (better than 99.99 percent) from a mixture of gases, and simultaneously formed it into simple shapes. The new technique makes possible close control in forming tungsten into tubing and other simple shapes, says Bureau director Marling J. Ankeny. With this method, it should be feasible to plate high-purity tungsten onto various surfaces, thus greatly extending the metal's usefulness.

The **Atomic Energy Commission** has awarded a $1,118,689 contract to **W. A. Klinger Inc.** of Sioux City, Iowa for construction of a Metals Process Development Building for the Ames Laboratory located on the campus of the University of Iowa, at Ames. The new building will provide space for research on larger-than-laboratory scale.

American Metal Climax Inc. is building a germanium refining plant at Carteret, New Jersey. It is expected to go into full operation during 1960, at the site of the Carteret plant of **U.S. Metals Refining Company,** a wholly owned subsidiary of American Metal. The plant will produce germanium dioxide from both primary raw materials and scrap, and will also have facilities for production of germanium metal. Concentrate will undoubtedly come from **Tsumeb Corporation Ltd.** in South West Africa, in which AMC has a substantial interest.

The **DuPont Company's** new titanium dioxide plant at New Johnsonville, Tennessee, is now in operation. Production is to be 125-tons per day.

Armour Agricultural Chemical Company is still seeking permission from the City of Bartow, Florida to mine an area of swampland inside the city limits. About 175 acres would be mined for phosphate over a 15-month period. This would be followed by a five-year land restoration project, which would include leveling windrows and soil banks and creating a 26-acre H-shaped lake in the center of the area.

The **General Services Administration** is disposing of approximately 3,060 short wet tons of rare earth material through its **Defense Materials Service.** The material is a byproduct of a chemical process used in the production of columbium-tantalum pentoxide, and was originally acquired in anticipation of a need by the AEC. It contains all 14 of the rare earth elements, and is in the form of a filtercake, packed in polyethylene bags, inside 30-gallon steel drums. The material is in storage in Granite City, Illinois. Contact George K. Casto, GSA's Defense Materials Service, Washington, D.C.

The **Metal & Thermit Corporation** of New York has formed a separate **Metals and Minerals Division,** headed by James L. Oberg as general manager. The new division will have responsibility for research, production, sales, and technical service for M&T metals and minerals, including ferro titanium, nickel titanium, chromium, rutile, and ilmenite. It will operate mining facilites at Hanover, Virginia, and mineral milling operations at Carteret, New Jersey. Mr. Oberg is also a vice president of **International Titanium Corporation,** and supervises its operations and those of its wholly owned subsidiary, **Metal Recoveries Pty. Ltd.** in Australia.

The **Tennessee Copper Company's** Milling Department is now producing Xanthate in a unit installed at Copperhill, Tennessee for this purpose. The new chemical is not being made for sale; it is used to replace a reagent purchased in New York state and shipped by freight to Tennessee at considerable expense for many years. Xanthate is a reagent that collects the desired minerals in the froth that comes to the surface during flotation. The chemical produced by TCC is in liquid solution and can be fed directly into the flotation plant. The previously purchased Xanthate was shipped in pellet form and had to be changed into solution.

Union Carbide Corporation's cost-plus-fixed-fee contract with the **AEC** for operation of four major AEC facilities has been extended to June 30, 1964. The present contract expires June 30, 1960. **Union Carbide Nuclear Company,** a division of the corporation, operates two large production plants and a research and development laboratory in Oak Ridge, Tennessee, and the gaseous diffusion plant at Paducah, Kentucky.

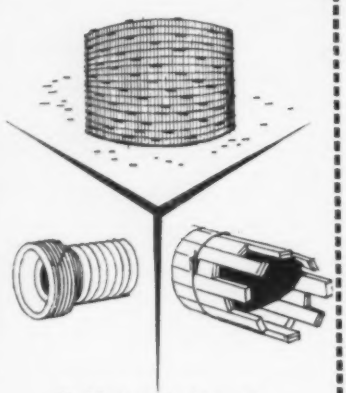
A $10,000 grant from the **National Aeronautics and Space Administration** has been awarded to **Boston University's** astronomy and physics department for the study of tektites, the black, glassy fragments of unknown origin, found on the earth's surface. The project is under the direction of Dr. Gerald S. Hawkins, who says the research will relate to geology and mineralogy, as well as astronomy and physics. They will seek to determine whether the fragments are earth-formed or extraterrestrial in origin.

Jones & Laughlin Steel Corporation has awarded a $26,000,000 engineering contract to **Arthur G. McKee & Company** for a blast furnace at the firm's Cleveland, Ohio works. The new furnace is part of a $50,000,000 expansion and cost reduction program, which also includes the installation of two new basic oxygen steel-making furnaces. The new furnace will be the first unit of its type in the steel industry to be blown in with axial flow air turbines.

Beryllium Corporation is making shipments of reactor grade beryllium metal to the AEC at a rate greater than called for in its contract. Under a five-year agreement, the firm is to supply 187,000 pounds at an annual rate of around 37,000 pounds per year. Specific shipments are not revealed.

Cessation of purchase for the government stockpile of manganese on August 5th virtually closed down the Erwin, Tennessee manganese district. Of the six companies that had been operating manganese mines, only **U.S. Manganese & Sulphate's Dry Creek** mine is still producing. Local operators fear that the price for the ore may drop from the government purchase price of $120 to $125 per ton to as low as $50 per ton.

The **Norton Company** at Worcester, Massachusetts reports it has developed a system for producing titanium by an electrolytic process which is expected to cut titanium costs. The system uses raw titanium carbide which is about 80 percent titanium. The process reportedly also can be used to produce columbium, vanadium, chromium, zirconium, thorium, tungsten, and other metals.



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CENTRAL AND EASTERN

The **Maine Geological Survey** has released a number of new publications: "Glacial Lake and Glacial Marine Clays in the Farmington Area, Maine"; "Geology of a Six-Mile Section Along Spencer Stream Somerset County, Maine"; "Mineral Resources of Maine Reference Map Series Portland-Bath Sheet"; "Maine Mining Law for State-Owned Land"; and Aeromagnetic and Geologic Reconnaissance Surveys of Portions of Penobscot, Piscataquis, and Aroostook Counties, or the Sidney Augusta and Gardiner Areas of Kennebec County. Copies may be obtained through the Survey at Augusta, Maine.

The **American Bureau of Metal Statistics** has published its 38th annual edition of its Yearbook for 1958. This edition records for 1958 and prior years, mine production, smelter production, consumption, imports and exports, and other economic statistics on a world-wide basis. Copper, lead, zinc, nickel, aluminum, bauxite, gold, silver, tin, antimony, cadmium, cobalt, magnesium, molybdenum, and platinum and sundry ores and metals are reported on in this statistical manual. The price is $4.50 a copy for the hard cloth-covered edition and $4.00 a copy for the soft paper-covered edition. For mailing outside the United States, add 25¢ for postage and handling. The Bureau is located at 50 Broadway, New York 4, N.Y.

A deposit of rare earth minerals uncovered in the course of mining iron ore at **Scrub Oaks** mine, Morris County, New Jersey, promises to become a "valuable byproduct", according to a publication issued by the **U.S. Geological Survey** as Bulletin 1082-B. The New Jersey rare earth minerals are mainly in coarse-grained magnetite ore and in adjacent pegmatite. They include xenotime and doverite aggregates and bastnaesite with intermixed leucoxene as the most abundant rare-earth constituents. Eleven samples of radioactive ore and rock were found to contain uranium, thorium and rare-earth oxides, including yttrium. USGS Bulletin 1082-B, "Radioactive Rare-Earth Deposit at Scrub Oaks Mine, Morris County, New Jersey" by Harry Klemic, A. V. Heyl, Jr., A. R. Taylor and Jerome Stone is available at 50 cents a copy from the Superintedent of Documents, **U. S. Government Printing Office.**

IRON RANGES

Inland Steel Company has acquired 10 percent of the stock of **Wabush Iron Company Ltd.** which has a long-term lease on a large iron ore deposit near the western border of Labrador, Canada. Other owners are **Youngstown Sheet & Tube Company, Steel Company of Canada Ltd., Interlake Iron Corporation,** and **Pickands Mather & Co.** Pickands Mather manages the firm. A pilot plant is under construction. Construction of permanent facilities is scheduled to start in 1961, and shipments are to start by 1965 at an initial rate of 4,000,000 to 5,000,-

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INTERNATIONAL NEWS

000 tons annually. Ultimate capacity is expected to be 10,000,000 tons.

In recognition of an outstanding safety achievement by the iron ore mining industry in Minnesota, a Joseph A. Holmes Certificate of Honor was presented to Governor Orville Freeman by the **U.S. Bureau of Mines.** A. D. Look, District Health and Safety Supervisor, U.S. Bureau of Mines, Duluth, Minnesota, presented the award to the Governor. The certificate was awarded for having no fatalities or permanent total disabilities in the underground and open-pit iron ore mines and beneficiation plants located in Itasca, St. Louis, Crow Wing, Fillmore, Lake, and Cook counties, which operated 26,484,675 man-hours during the year 1958 and continuing, with an average of 14,806 men.

A recent study of injury rates has shown a definite reduction in accidents from falls of persons in Lake Superior District mines. This had been a leading cause of injuries until a safety campaign was launched by the **Lake Superior Mines Safety Council** and the **U.S. Bureau of Mines.** Man-hours for 12 participating companies for the period February through June 1959 increased 32 percent over a similar period in 1958, but frequency of "falls of persons" accidents was reduced slightly more than 30 percent.

Ashland Mining Corporation has purchased 760 acres of land in the Town of Mercer from the Iron County, Wisconsin Board at a price of $5,458. The firm is developing low-grade iron ore deposits in Ashland County, west of the Mercer tracts.

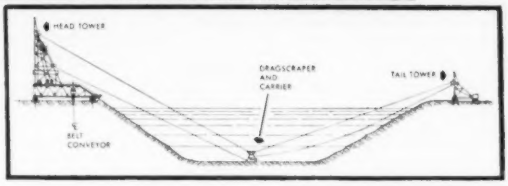
A freak blast of superheated steam has been blamed for the deaths of six men last June 1 at the **Sherwood** mine near Iron River, Michigan. The blast was blamed in a **Michigan State Health Department** report, prepared by Jack M. McKichan, Marquette, and based on an inquiry by the district engineer, the **U. S. Bureau of Mines,** company officials and the county mine inspector. The report discounted theories that the explosion resulted from a concentration of gas or from hydrogen generated by water flowing over hot slate, but indicated that a basic factor was a slate fire in an abandoned stope. Ground movement probably caused water from an underground pool to fall onto the hot slate, the report said, producing a jet of hot steam that resulted in the miners being exposed to temperatures as high as 1,000°. The report, in recommendations made to prevent a repetition of the disaster, said there should be "close liaison between supervisory personnel of all adjoining properties in respect to any and all conditions close to property lines."

Ashland, Wisconsin will ship iron ore in the future from the **Soo Line Railroad** Docks only. It has been announced that the **Chicago and Northwestern Railroad** Dock will be dismantled completely, and that the two railroads will utilize the Soo Docks in the future. The **Minnesota Lumber and Wrecking Company** has been awarded the contract for dismantling of the wooden dock. The Soo Dock is a concrete-steel structure.

Tough Digging, Long Hauls... Routine Jobs for Sauerman DragScrapers

240-Ft. Bank... 350-Ft. Haul

This mobile Sauerman Tower Excavator digs 480 yds. per hr. on an average haul of 350 ft. from a high bank to a portable field hopper. The 12-yd. Crescent DragScraper operates between steel head and tail towers. The towers are mounted on two sets of railroad tracks and ride on four sets of trucks. DragScraper power is supplied by two hoists mounted on the head tower. One hoist operates the load and pull-back cables, the other is used to tension the track cable. The hoists are controlled by one operator located in the cab on the tower. The load cable handles over 400,000 tons of material before replacement.



Drawing shows typical mobile tower excavator digging in wet pit.

75 Ft. Under Water... 800-Ft. Span

A 5-yd. rapid-shifting DragScraper supplies about 200 yds. per hr. to the plant hopper in background. Bridle tower in foreground is one of two supporting the bridle shifting cable which is controlled by the third drum of the Sauerman hoist. Lateral shifting of the DragScraper's line of operation is readily accomplished by power-shifting the trolley and tail block to a new position on the bridle cable. The DragScraper is digging 75 ft. under water and the operating span is 800 ft. from head frame to the bridle towers. Over a million tons have been excavated from this pit. The DragScraper often operates 24 hrs. a day to handle contract demands.

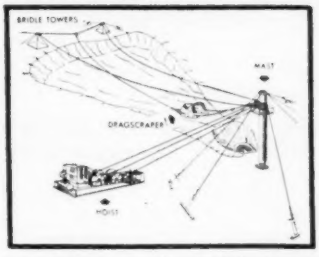


Diagram shows details of Sauerman rapid-shifting DragScraper.

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Alcoa Allocates $200,000 To Explore Jamaica Bauxite

The Aluminum Company of America reached an agreement with the Jamaican government and Caribex Ltd. this summer for options on certain bauxite land near Kingston (see MINING WORLD, August 1959, page 7). The location of this leased area can now be noted on the accompanying map.

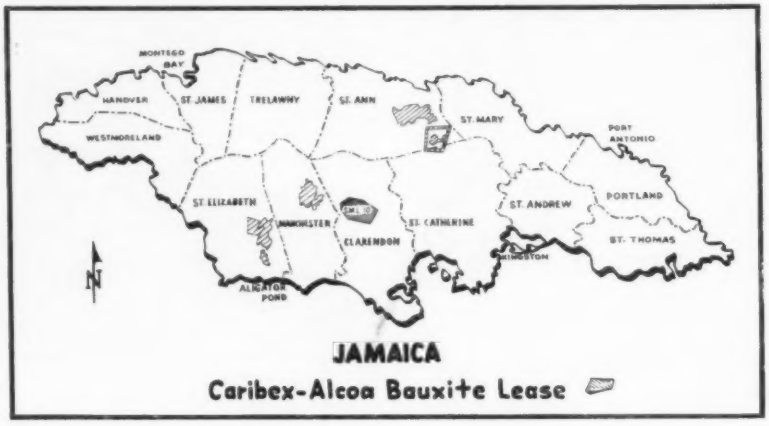
The Special Mining Lease (designated as SML 10 on map) was first granted to American Metal Company Ltd. in August 1957. It covered a 50-square mile area for a period of 10 years. This company subsequently became American Metal Climax Inc.

The first year's lease was to be regarded as a prospecting period, and the second and third years as a period of development and construction. In June 1958, the lease was transferred to Caribex Limited, a wholly owned Canadian subsidiary of American Metal Climax.

Caribex carried on active prospecting during the prescribed period and proved what is considered to be a bauxite deposit of commercial size. The company did not undertake the construction and development program, however.

Alcoa has undertaken to fulfill the original obligations, except for a variation in time clauses. The firm plans to spend $200,000 by May 1960 for exploration work in order to make its own evaluation of the deposit. It has given no commitment that it will build an alumina plant. If tests meet expectations, Alcoa can then lease the land from Caribex.

Other United States firms are mining bauxite leases on the island. On the map, note that Kaiser Bauxite Company is operating in St. Elizabeth; Alumina Jamaica Limited, in Manchester; and Reynolds Jamaica Mines Ltd. in St. Ann. The lease areas shown here are no indication, however, of the property these companies hold as reserves for their operations. Alumina Jamaica hopes to have its second alumina plant completed this year. It is located at Ewarton, 50 miles from the first plant, and will have a capacity of 250,000 tons when in full production.



Vaal Reefs Regains Sinking Record – 922 Feet

Vaal Reef Exploration and Mining Company Ltd. has regained the world shaft sinking record for one month's advance. In September, around the clock shaft crews at the No. 2 shaft in the Union of South Africa set the new record of 922 feet. The new record was made in sinking the 26-foot, inside-diameter, round shaft from a depth of 1,152 feet to 2,054 feet. Concurrently with sinking, the shaft was concrete lined.

In setting the new record, a 170-hole round was drilled and blasted; a mechanical grab suspended from the bottom of the six-deck sinking stage loaded the broken rock into 10-ton buckets for hoisting to the surface, while concrete lining was placed behind movable steel forms from the sinking stage. One movable deck on the stage speeded concreting and gave the same efficiency as would have been realized with a longer stage with more decks. Favorable to the record was the relatively shallow shaft at time record was set and the use of the 10-ton skips for hoisting rock.

September seems to be a favorable month for breaking shaft sinking records in Africa; the world record just broken was only two years old in September. Holding the record since 1957 was the Free State Saaiplass Gold Mining Company, Limited which sank and concrete lined its 27.5-foot, inside-diameter, round shaft 834 feet.

This is the third time the Vaal Reefs company has held a shaft sinking record: twice for greatest footage, and once for greatest footage by hand mucking a shaft. In March 1955 the world record of 667 feet was set in the company's No. 1, 18-foot-diameter, round No. 1 shaft. In January of the same year, the world hand mucking record of 590 feet was set in the same shaft. The March record was for any type of shaft with any time of mucking; in this case, hand. It seems almost certain that the company's hand record will never be broken, or even challenged as the rapid advance during the last year of several types of mechanically operated grabs has doomed hand mucking as too slow and costly. These grabs hung below the sinking stage drop the cactus (orange peel) grabs into any part of the shaft bottom. Multiple buckets hoisted by one of several hoists are used with the grab.

Ultimate depth of the new No. 2 shaft will be about 7,200 feet to develop the fold and uranium-bearing Vaal reef in the south central section of the company's mining claims in the Klersdrop district of the Union of South Africa.

ONTARIO—**Anaconda Company (Canada) Ltd.** is finishing construction of its 100-ton pilot plant at the **Nakina** property in Ontario. The project also called for building of truck roads to Nakina. K.O. Sweeney is metallurgist in charge of plant construction and process development. The firm has been drilling in the Armstrong Block area, and is also driving an adit on its **Caribou** property.

BRITISH COLUMBIA—**Giant Nickel Mines** has entered into a three-year contract with the Japanese firm, **Sumitomo Metal Mining**, for sale of all nickel concentrates from its mine near Hope, 100 miles east of Vancouver. First shipment is to be made in February. Before that time, Giant Nickel will complete its present concentrate contract with the **Sherritt Gordon** refinery at Fort Saskatchewan, Alberta.

QUEBEC—**Aluminium Company of Canada Ltd.,** has decided to suspend magnesium operations at its smelting facilities at Arvida. The magnesium plant had a capacity of 4,000 tons annually as a minor division of the aluminum operations at Arvida, and had been producing less than that for some time. In the future, Alcan's associate, **Magnesium Company Ltd.**, will buy magnesium from **Dow Chemical Company** in the United States and **Dominion Magnesium Ltd.** in Canada. The arrangement with Dow is on an exchange basis, with Alcan delivering a pro-rata tonnage of aluminum ingot for the magnesium.

BRITISH COLUMBIA—**Bethlehem Copper Corporation** is awaiting results of the underground drilling program recently carried out by consulting engineers on its copper property in the Highland Valley. The program was in progress for about 15 months at a cost of about $1,000,000. Total cost of development is now about $2,500,000.

INTERNATIONAL

QUEBEC—Surface prospecting in the Chibougamau district by **Campbell Chibougamau Mines** and **Chibougamau Mining and Smelting Company** has disclosed evidence of gold and copper. A camp has new been established and a crew is carrying out additional trenching. A detailed electromagnetic survey and diamond drilling are also being carried out. The property is known as the **Y-6** group, and consists of 21 claims. An additional 45 claims adjoining the find have since been staked.

ONTARIO—**Premium Iron Ores Ltd.** plans to build a $10,000,000 steel plant in the Fort William-Port Arthur area on Lake Superior. The plant would treat iron ore from Steep Rock Iron Mines using the direct reduction HyL process of **Canadian Kellogg Company.**

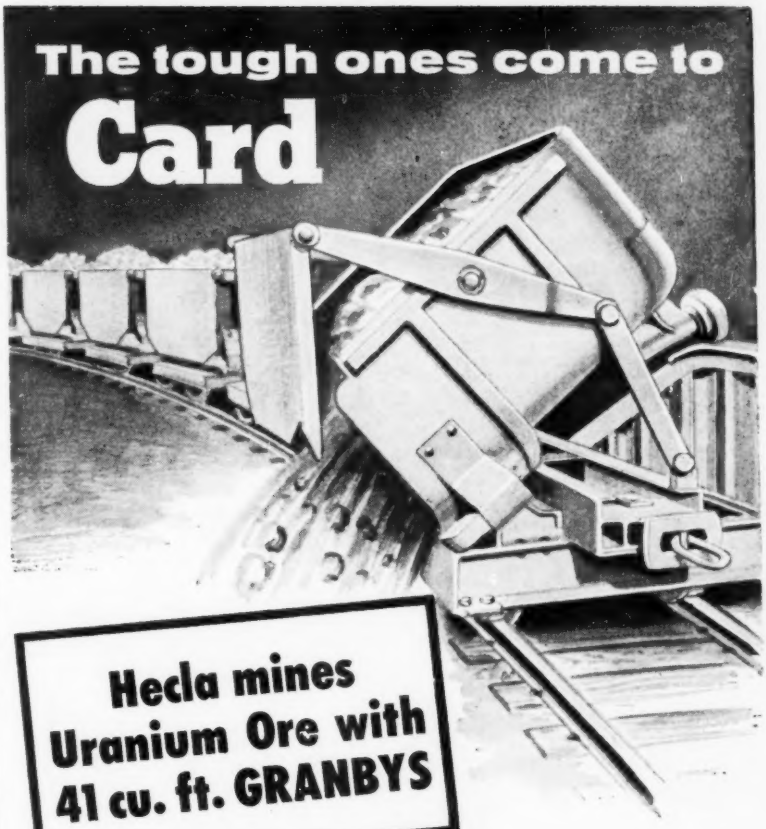
SASKATCHEWAN—Aerial geophysical surveying by **Augustus Explorations** over 500 square miles of a 3,000-square mile area recently leased from the government has indicated some favorable magnetic zones. The property is in the Reindeer Lake-Lac La Ronge area. Explorations rights on 250 square miles of the surveyed area will be acquired by **Hydra Explorations** which is in the process of being formed by the merger of 11 firms. Hydra will also acquire rights over another 250 square miles of the withdrawn territory.

QUEBEC—**Falconbridge Nickel Mines** has taken a six-month option on a nickel property in La Motte Township, owned by **Marchant Mining Company.** Falconbridge will carry out a minimum of 5,000 feet of diamond drilling to evaluate the nickel deposit. If Falconbridge exercises the option, a new company will be formed on a 50-50 basis, and shaft sinking, mill installation, etc. would be undertaken. The property must be brought into production by January 1, 1963 if this step is reached. Also Falconbridge would agree to purchase all of the nickel-copper concentrate produced by the new company through 1965.

ONTARIO—**Nickel Mining and Smelting Corporation** has unwatered its main shaft at its **Gordon Lake** nickel-copper property and is now undertaking an underground exploration program. Drilling to test zone A at depth is being carried out in two separate headings on the 1,200-foot level. Check sampling is being done on the third level to check the B and G zones. Special emphasis will be given to determining the platinum group metal content. Sales of power from the company's power plant at Chicoutimi, Quebec are continuing in sufficient volume to pay operating costs. Original plans for constructing a nickel smelter at Chicoutimi appear remote at this time.

NORTHWEST TERRITORIES—**Ruth Gold Mines Ltd.** of Alberta has leased the old **Ruth** gold mine of **Consolidated Smelters** in the Yellowknife area and given the district its first new gold producer in many years. The lessees have de-iced the shaft, and dewatered underground working. The 25-ton mill has been reconditioned and already has produced its first gold bars. The property was developed in 1940 and closed down because of the wartime manpower shortage.

QUEBEC—Shaft sinking has started at the gold property of **Marban Gold Mines**



Hecla mines Uranium Ore with 41 cu. ft. GRANBYS

Hecla Mining Company opened their Radon property with 20 small Granby-type Card cars designed specifically for this underground service. Hecla is operating one of the deepest uranium mines in the U.S.A. with a well planned mine plant.

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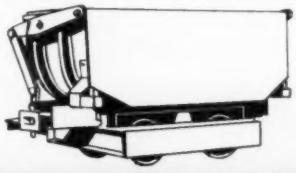

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in the Malartic district. The shaft will be three-compartment, and will be sunk to an initial depth of 685 feet. Levels will be established at 200, 350, 500, and 650 feet. There is to be a minimum of 3,000 feet of lateral crosscutting and drifting to explore the indicated gold-bearing zone, as well as at least 10,000 feet of underground drilling.

BRITISH COLUMBIA — A gold discovery at the old **Camp McKinney** mine 16 miles west of Rock Creek on the southern Trans-Provincial Highway has been rated by **Hill, Starck & Associates,** consulting engineers, as the most important in the province since discovery of the **Zeballos** gold camp on Vancouver Island more than two decades ago. The firm is directing a program designed to put the property in production at a rate of 50 tons per day. **Giant Mascot Mines, Ltd.,** is managing the development.

SASKATCHEWAN — A 61,280-acre potash property located about 15 miles east of Saskatoon has been acquired by **Consolidated Morrison Explorations** in a purchase agreement with J. H. Low and H. F. Morrow. Payments for the property will total about $175,000 when finally completed, along with 100,000 shares of Consolidated stock. The property adjoins **Potash Company of America.** Three holes drilled cut good thicknesses of high potash content at an average depth of 3,275 feet in the No. 1 bed. The holes also cut four additional beds at greater depth. Further drilling is being continued. Consolidated Morrison is expected to give up its option on another potash property in the Esterhazy area of Saskatchewan.

MANITOBA—This is the new Thompson headframe of **International Nickel Company of Canada** now towering above the **Thompson** nickel mine production shaft. Sinking of this 2,100-foot shaft was completed in 1957 and the 1,057-foot development shaft in 1957. To date, more than 66,000 feet of underground development has been completed from these shafts. The mine's two big friction hoists are now being assembled in the top of the headframe. In the photograph, the lower left portion of this massive concrete structure contains the coarse ore bins, which have a capacity of 2,000 tons. The temporary hoisting ropes used in the mine development operations appear at lower right. Operations are to start in 1960 with an annual rate of 75,000,000 pounds of nickel to be attained in 1961. Early this year, Inco announced that Thompson will also be the site of a new nickel refinery featuring the direct electrolysis of nickel matte, an Inco-developed process that eliminates high-temperature reduction and oxidation operations.

BRITISH COLUMBIA—Installation of a 100-ton mill is planned by **Pacific Western Metals Company** of Vancouver at the **Tamarac** gold-silver mine near **Ymir.** Pacific Western purchased the mine recently for $300,000 from **Tamarac Mines, Ltd.,** which had been operating a 35-ton mill on dump ore. George Powell of Ymir is general manager of the Tamarac firm.

ONTARIO—**American Nepheline Ltd.** has been granted an Exploratory License of Occupation over 570,240 acres in the district of Cochrane. This covers 11 full townships with the exception of areas that have previously been leased. The license is to explore for kaolin, fire clay, ball clay, and silica sand only, and covers no other minerals. It also does not confer surface rights. The license is for three years, and calls for expenditure of at least $125,000 in exploration, metallurgical testing, and market research. If the company finds a commercial deposit, it will be given a 10-year lease with option for renewal.

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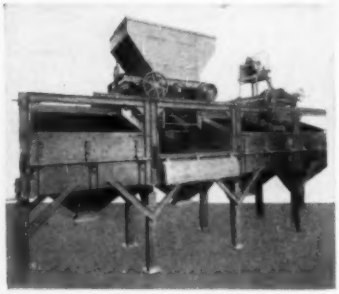

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INTERNATIONAL

CYPRUS—Following an exhaustive test of over 1,000 tons of Limni semi-oxidized ore, **Cyprus Sulphur & Copper Company** has decided to resume milling operations. Initially, the plant will treat 400 to 600 tons of ore per 24 hours, using an all-flotation plant. A good return is expected from these operations during the next four to five years, subject to metal prices being maintained on a satisfactory level.

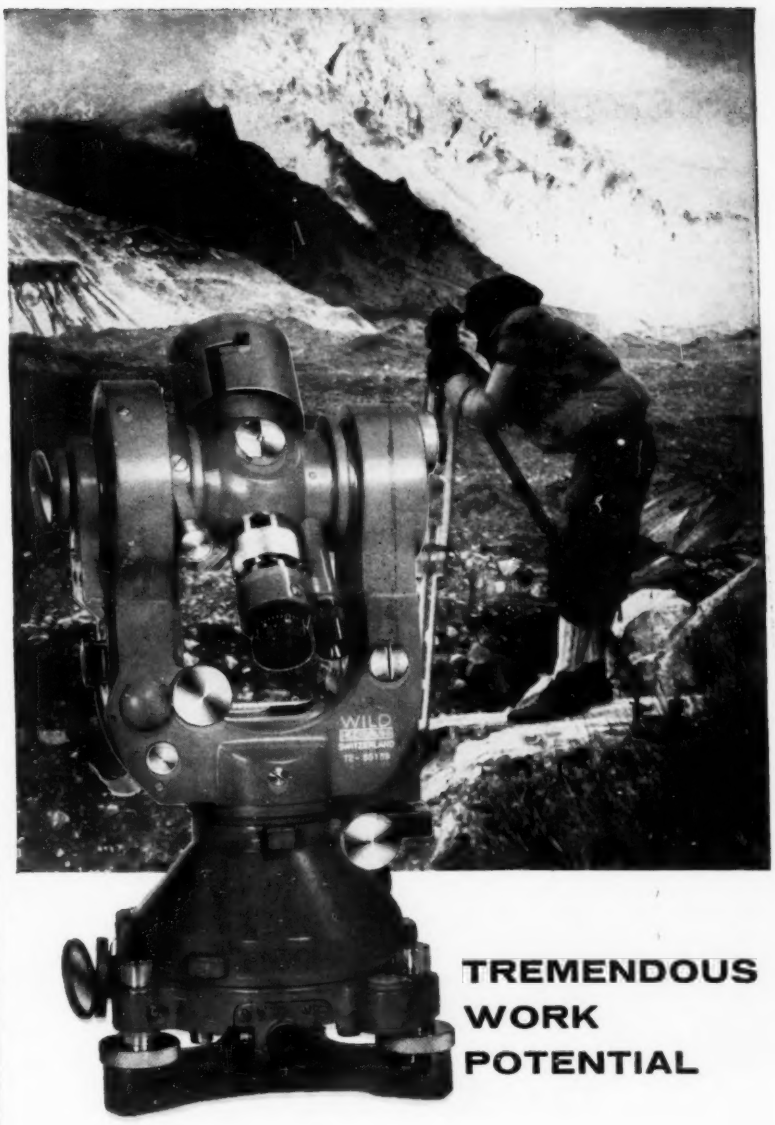
INDIA—The **Indian Copper Corporation** is ready to proceed with plans for a £700,000 project for the manufacture of electrolytic copper as soon as the government approves its application for necessary foreign exchange. Last year, the firm milled 442,088 tons of ore, compared with 440,671 in the previous year. Resultant metal production, however, was seven tons less than the 1957 record of 7,848 tons.

JAPAN—**Kobe Steel Works** has signed a technical tie-up contract with two **Aluminium Ltd.** of Canada subsidiaries, **International Aluminium Company** and **Aluminium Laboratories Ltd.**, for their assistance concerning production and sale of aluminum. Kobe expects to cut its production costs considerably with the introduction of new industrial techniques and shipment of their products through the big sales network of the Canadian firms. Recently, **Furukawa Electric Company** made a technical and financial assistance arrangement with the **Aluminum Company of America** and set up a new aluminum plant. Rolled aluminum production in Japan last year totaled 70,000 tons, an increase of 8,000 tons over the previous year.

MALAYA—**Sungei Besi Mines Ltd.** proposes to take over the large Chinese-operated tin property, **Hong Fatt.** The Sungei-Besi property alone has been estimated to have a life of at least 50 years. The absorption of Hong Fatt means that the combined ground will contain a lifetime's supply of tin.

ISRAEL—A new firm, **Israel Ore Processing Company**, reportedly has been formed by Cypriot-Israeli interests to establish a copper refinery in Haifa for processing of copper pyrites from Cyprus. Total investment is estimated at £4,000,000 Israeli. The Israeli government would also lend £1,500,000 Israeli. Production is to start in January 1961, according to present plans, with an initial output of 30,000 tons a year. About half of this would be exported to Europe. In addition, a sulphuric acid plant may also be erected.

INDIA—Press reports from India indicate that Russia has offered Rupees 180 crore in financial aid for India's Third Five-Year Plan, and that the offer has been accepted by the Indian government. Shri Swaran Singh, Minister of Steel, Mines, and Fuel, and Shri Manughai Shah, Minister of Industry, participated in discussions with Soviet officials in Moscow about external assistance to



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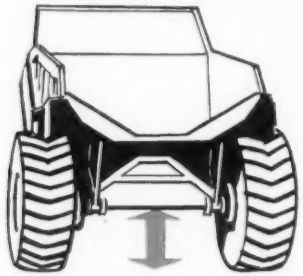
With an Allis-Chalmers TR-260 rear dump

...you get that extra measure of power and capacity—to speed the toughest hauling jobs. This 230-hp rear-dump haul unit moves 20-ton loads at speeds up to 28 mph . . . outworks and outproduces conventional haulers around mines and quarries.

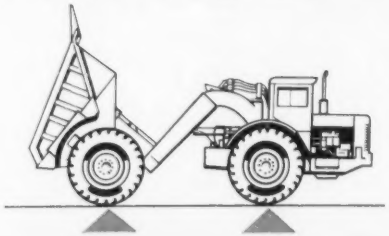
You'll find it easy to move with a TR-260. It often saves time and money by moving over adverse terrain to cut hauling cycles in half. Watch this unit at work . . . be convinced that your next big move should be with an Allis-Chalmers TR-260.

Two TR-260 rock wagons (part of a team of six units on the job) speed 20-ton loads up steep grades and over rough terrain. Big, low-pressure tires "float" machines over all obstacles . . . help make handling these giants a pleasure.

Can your haulers match these big TR-260 advantages?



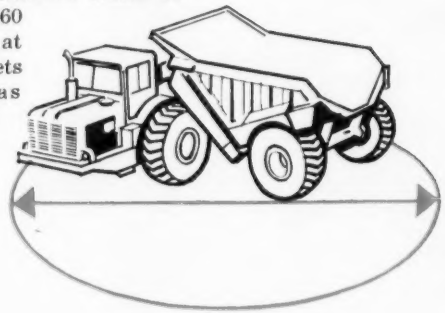
High ground clearance—25¾-in. wagon clearance lets the TR-260 roll over high spots without hanging up . . . move through softest footing without bogging down. KON-TORK differential automatically controls torque to each drive wheel . . . keeps the TR-260 moving in all kinds of conditions.

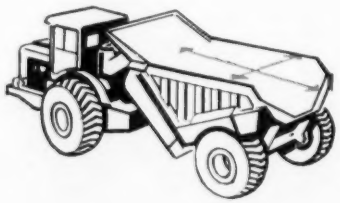


Safe, sure dumping—The TR-260 dumps with all four wheels braked . . . no need to back up tractor to get loads out. On the getaway, power is on the forward wheels where footing is solid.

KON-TORK is an Allis-Chalmers trademark.

Short turning radius—24 ft, 9 in. is all it takes for a complete turn with the TR-260. That's a lot less turning space than conventional trucks require. That's why the TR-260 spots faster under shovels and at hoppers . . . that's why it gets away from congested areas quicker than most haulers.





Easy loading—Big 11-ft, 2½-in. x 8-ft target area makes loading a snap with all types of overhead loaders. Low rear entry reduces height that shovel has to be raised. Front body extension protects operator's cab and steering jacks.

Interchangeability Reduces Equipment Investment—You can get double value from your TR-260 rear-dump unit. It interchanges with the TS-260 motor scraper. Both units match the same tractor . . . and can be interchanged in a few hours. The TS-260 is a high-production earth mover; the TR-260, a rugged hauler of overhead loaded materials.

Your Allis-Chalmers dealer can show you how these powerful, high-speed units can bring you extra profit insurance the year 'round—whether handling dirt or rock. Allis-Chalmers Construction Machinery Division, Milwaukee 1, Wisconsin.

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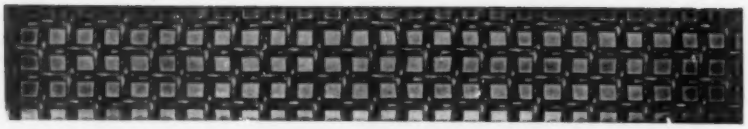
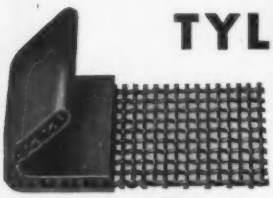


TYLER SCREENS LAST LONGER



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Indian economic development which led to this offer.

MALAYA—The **International Tin Council's** increase in the export quota for the last quarter of this year is expected to enable many Malayan mines to reopen. The increase is from 25,000 to 30,000 tons. Malayan tin mines had an export quota of 9,437 tons in third quarter, and this is expected to rise to at least 11,324 tons. About 670 gravel pump mines have been operating and the new increase is expected to encourage about 40 more to start operations.

CEYLON—The **Ceylon Mercantile Chamber** is still seeking a waiver of the present export duty on graphite. Export has been steadily dropping over the past few years—9,870 tons in 1955, 9,207 in 1956, 8,190 in 1957, and 5,629 tons in 1958. Ever increasing competition from other sources, particularly West Germany, Norway, and recently Kenya, coupled with rising production costs in Ceylon and the export duty of Rupees 50 per ton, are threatening to destroy the graphite industry in Ceylon, according to the Chamber.

JAPAN—**Mitsubishi Metal Mining Company** reportedly will invest 500,000,000 yen in expansion of its Akita zinc plant starting next spring. The company plans to increase monthly capacity from 800 tons to 1,300 tons. This figure will be added to the existing capacity of 1,150 tons at the **Hosokura** mine and 400 tons at Naoshima, bringing the firm's total capacity to 2,850 tons.

ISRAEL—A Japanese industrial mission reportedly has been discussing possibility of a loan to Israel for expansion of the **Israel Mining Corporation's** copper plant at Timna. The Timna project currently produces about 9,000 tons of cement copper annually; the expansion would be to double this output. Repayment of the loan would probably be in shipments of cement copper to Japan.

OCEANIA

WESTERN AUSTRALIA — **Ravensthorpe Copper Mines N.L.** is seeking more capital in order to increase development work to the point where ore production will become 10,000 tons per four weeks. Japanese smelters have sent a team of engineers to the mine to investigate the company's properties. However, there is some doubt about whether Australia would permit the Japanese industry to develop Australian resources. At the company's **Elverdton-Desmond** mine, a length of 682 feet of ore was proved recently, averaging 2.71 percent copper over an eight foot width. The treatment plant already has a capacity of 10,000 tons per month so the company is reopening the **Cattline** mine in the town of Ravensthorpe, 7 miles north of Elverdton. This ore body is smaller but of higher grade than Elverdton and is expected to yield 1,500 tons per month assaying over 3 percent copper and 2 dwts of gold per ton.

INTERNATIONAL

REPUBLIC OF THE PHILIPPINES—**Philex Mining Corporation** set another milling record at its Santo Tomas plant in Mountain Province in August. During that month the plant milled 49,980 tons of disseminated ore, highest tonnage since the plant went into operation about a year ago. In July the previous high was set. The August tonnage yielded 1,054 tons of concentrates estimated to contain 556,066 pounds of copper and 1,082 ounces of gold. Total value of the output, which also included some silver, was Pesos 473,442, the highest recorded by the firm in any single month so far.

NEW ZEALAND—The discovery of an iron-rich, low silica bauxite has been announced in the North of New Zealand. The Pederson process has been suggested for smelting because it operates commercially on iron-rich bauxite in Norway. The find is said to be five square miles in area, with possibilities of extension over another 35 miles. A prospecting program is being planned for the coming summer and **Rio Tinto** interests are reported to have filed applications.

NORTH BORNEO—The British government of North Borneo has consented to the sending of technical experts to the country by private Japanese firms. Local Japanese companies will be permitted to be established in order to help in development of local mining, oil, fishery, and paper pulp industries.

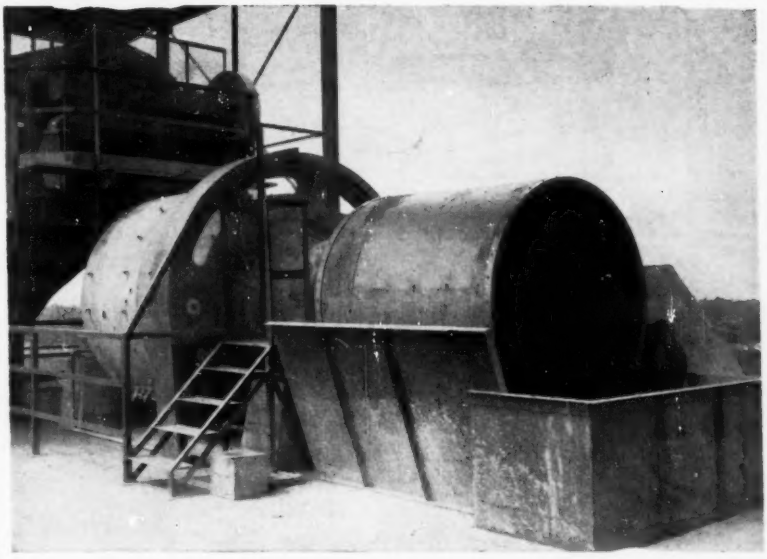
WESTERN AUSTRALIA – Japanese interests are reported to be desirous of purchasing leucoxene from sand deposits in the Capel and Bunbury areas. The **Morimura Brothers** are said to be the group. In the quarter ended July 16, **Western Titanium N.L.** at Capel produced 15,518 tons of ilmenite, 1,467 tons of zircon, 90 tons of monazite, 77 tons of rutile, and 62 tons of leucoxene.

REPUBLIC OF THE PHILIPPINES—The **Pagadian Iron Mines Company,** an affiliate of two Japanese firms, has signed an option to develop the rock phosphate deposits of **G.Y. Ornopia and Associates Inc.** which were found on Negros Island (see MINING WORLD, June 1959, page 28). Two Japanese experts, Yawato Aso of **Toa Phosphate Company,** and Dr. T. Yamaguchi of **Meiji Mining Company Ltd.,** examined the property and signed the option to have their Philippine affiliate operate the property on a royalty basis. The firm's discovery created great interest in phosphate prospecting. **C.Y. Antoni and Associates Inc.** is now making intensive examinations of its **Magamihan** rock phosphate properties, and is reported to have indications for about 500,000 tons assaying about 40 percent P_2O_5.

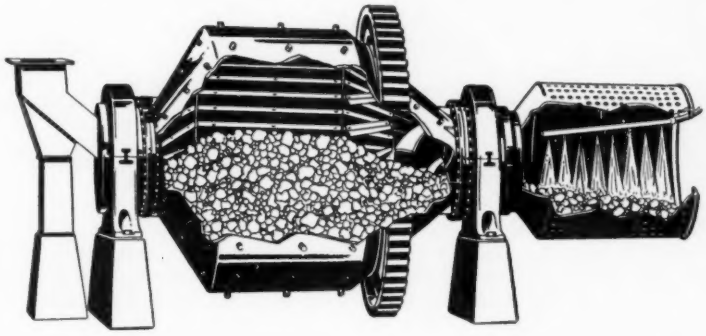
NEW ZEALAND—Work is continuing toward proving of the Paparoa uranium province where extensive new discoveries were made during the past year. Geologically, the province is very similar to that of the Colorado Plateau in the United States.

REPUBLIC OF THE PHILIPPINES—**Furukawa Mining Company** of Japan has sent an engineer to the Philippines to examine the Agusan copper mine of

HARDINGE SCRUBBERS FOR PIT-RUN MATERIALS



The 8′ x 48″ Hardinge Conical Scrubber, above, 6′ x 6′ dewatering screen kept a west coast sand and gravel firm in business, after their high grade deposit was exhausted—successfully removing large quantities of extremely sticky clay from their quarry stone. Hardinge conical scrubbers are in operation throughout the country, cleaning crude iron ore, sand, gold ore, dolomite, river gravel, and crushed stone of all types.



Large diameter, short length trunnions permit chute feeding of unsized ore and rock at rates up to 600 tons per hour.

The mass loading and ball-mill action in the scrubber quickly and completely slurries the clay and dirt, permitting ready separation on washing screens or trommels.

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Manila Mining Company on Mindanao Island. Furukawa hopes to participate in development if the property warrants it.

CHILE—**Compania de Aceros del Pacifico**, owner of **El Algarrobo** iron mine, plans to start shipping ore in January 1960 to the United States, England, Germany, and Argentina. Shipments will be made through the mechanized port of Las Lozas near Caldera in the Atacama province.

COLOMBIA — **Choco - Pacifico Gold Mining Company**, a subsidiary of **Anglo-South American Gold & Platinum Company**, has applied for concessions on 60 gold mines in the municipality of Remedios, Department of Antioquia, bordering on the Department of Bolivar. This group covers some 2,500 hectares. The quartz veins are believed to contain gold in commercial quantities, and it is expected that necessary machinery for operations will be installed this year. The exact location of the territory is in the Cordillera Central, known as Serrania de San Lucas, which runs into the Department of Bolivar as far as the municipality of San Martin de Loca.

MEXICO—The first shipments of tungsten and molybdenum to cross the United States border at Douglas, Arizona in more than a year, entered the U.S. in September. The shipments included 56,000 pounds of tungsten produced by **Cia. Minera Benwilco** and **Minerales de Nacozari**, and 18,000 pounds of molybdenum produced by Benwilco. The shipments were purchased by the **Fred H. Lenway Company** of San Francisco for use in hardening steel.

PERU—**Acari Iron Mining Company (Compania Explotadora de Hierro de Acari)** made its first shipment of iron ore early in September through the Port of San Juan, south of Lima. The **Bethlehem Steel Company** freighter loaded about 24,000 tons of ore destined for open hearth operations in the United States. Bethlehem has a long-term contract for purchase of a large portion of the Acari production.

BOLIVIA—**South American Placers, Inc.**, wholly owned subsidiary of **South American Gold & Platinum Company**, has dedicated its new gold dredge after almost a year of work. The dredge was purchased from **Bulolo Gold Dredging Ltd.** in New Guinea, dismantled, overhauled, and shipped to Bolivia. Bolivian government officials and company officers from New York were on hand for the dedication ceremonies. Fully developed reserves in the Teoponte area, where the dredge will operate, are now 28,168,000 cubic yards of gravel with an estimated recoverable content of 55.0 cents per cubic yard. There are also partially developed and potential reserves in the same area totaling about 24,202,000 cubic yards. Scout drilling in the Mapiri area, which is not contiguous to the Teoponte area, appears promising for a possible second dredge; however, extensive prospect drilling now in progress will be required before a definite decision can be made.

PERU—The **Andacollo Mining Company Ltd.** of Toronto, Canada is completing final arrangements for setting up a 200- to 250-ton mill on the **Cerro Landa** copper property. Preliminary work over the last few years, at a cost of about $150,000, has proven several hundred thousand tons of 6 percent and better copper in an enriched zone, according to Howard Steven Strouth, president; a possible multi-million-ton orebody of 3 percent copper adjoins. Cerro Landa covers 12 square miles of surface area, and additional 18 square miles have been stacked.

YUGOSLAVIA—Three years of systematic geological surveying have disclosed about 2,000,000 tons of ore at Zute Prline in the Kopaonik Mountains, containing 5 percent lead and 4 percent zinc. At Blagodat in the Besna Kobila

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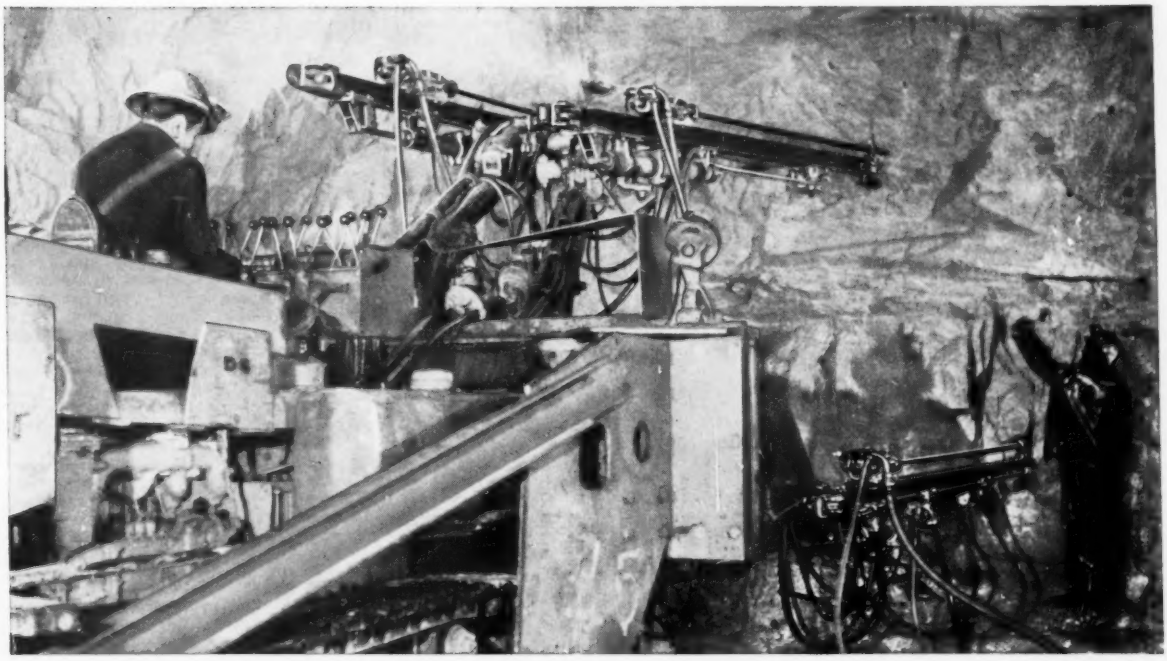
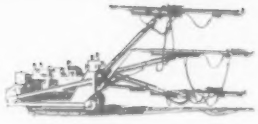
speed underground drilling in Canada's URANIUM MINING BOOM





Unlike the gold rush of Klondike days, the uranium boom in Canada's Algoma Elliott Lake area is spearheaded by the most efficient *mechanized* equipment. To speed up drilling with minimum effort, the Panel Mine of Northspan Uranium Mines Ltd. is using four Ingersoll-Rand Hydra-Boom drilling rigs, one of which is shown above, operating 1700 feet below the surface.

Each tractor-mounted rig carries three heavy-duty I-R drifter drills mounted on Ingersoll-Rand Hydra-Booms, providing smooth effortless hydraulic control of all drill motions. Booms are raised or lowered and swung from side to side and drill guides are extended, retracted, dumped and swung at the touch of a throttle—all drills easily controlled by one rig operator. Using 1⅛″ round steel and 1¾″ tungsten carbide insert bits, these rigs are used in a room and pillar trackless mining operation, teamed with 48″ ramps mounting 30-hp I-R slusher hoists.

I-R Hydra-Booms represent the last word in *mechanized* rock drilling—convert setup time into drilling time and increase production by as much as two-to-one. Rugged, versatile and easy to operate, Hydra-Booms are designed and built to withstand the punishment and abuse inherent in underground mining operations. Swing and lift cylinders are double acting, fast moving, and locked to prevent dropping the boom if hydraulic lines are broken.

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Mountains near Bosiljgrad, a 200,000-ton deposit containing 8 percent lead and 7 percent zinc has been found. Total reserves there are expected to approximate 500,000 tons. Magnetic ore has been found at Suva Ruda in the Kopaonik Mountains (about 450,000 tons) and near Vranje (400,000 tons).

SPAIN—Applications have been received by the authorities asking for a doubling of flotation plant capacity of **Escombreras de Azuaga** near Badajoz. **Minas de Soterrada** near Oviedo will also expand its plant for mercury production, while **Asturian-Belgian de Minas** will build a plant for mercury byproducts in Oviedo.

LUXEMBOURG—In the first seven months of this year, iron ore output in the **European Coal and Steel Community** totaled 50,700,000 tons. This was a decrease of 1,200,000 tons compared with the same period of 1958. The largest drop was reported from West Germany where iron ore output declined by 476,000 tons.

YUGOSLAVIA—Production of mercury at the **Idria** mine, one of Europe's largest mercury producers, has steadily increased this year. In the first four months, the mine produced 152 tons, or 27 tons (22 percent) more than in the same period of last year. A similar increase reportedly has been made in the first seven months of this year, so it appears that the mine may achieve its goal of 500 tons this year. In 1956 annual output was 456 tons; in 1957, 425 tons; and in 1958, 423 tons.

SPAIN—Kaolin activities in the province of Lugo appear to be increasing. **Minerales y Productos Ceramicos** has acquired a German partner under the liberalized state regulations governing foreign participation, and has increased its kaolin washer capacity to 25,000 tons per annum with the aid of imported machinery. The firm of **Basaguri** has set up a new kaolin washer in Foz (Lugo). Kaolin deposits in the Valle del Oro are now estimated at 1,000,000 tons.

UNITED KINGDOM—The **International Congress on Mineral Processing** will meet in London from April 6 to 9, 1960. Sessions will cover comminution, flotation research and practice, gravity and dense medium separation, magnetic and electrical separation, chemical processing, etc. For information, write to The Secretary, **Institution of Mining and Metallurgy**, 44 Portland Place, London W.1.

THE NETHERLANDS—**M. A. Hanna Company** of the U.S.A. has joined with the **W. H. Muller Company** in building a bulk cargo facility in the Port of Rotterdam. Muller is the ore merchant for Labrador ores in Continental Europe. Since the shipping season from Seven Isles (Canada) is so short, it was necessary for ore carriers to unload quickly and return. There was little storage space on shore, however, and so unloading was often delayed for several days. The new dock now speeds unloading, and provides adequate storage space, and equipment for loading Rhine River barges for transshipment to West Germany.

FRANCE—The country's iron ore production for the first half of 1959 amounted to 30,725,000 tons, or only 235,000 tons less than the output during the same period of 1958. French ore stocks at the mines, however, increased to more than 5,500,000 tons on June 30, 1959, compared with 4,000,000 in the same period of 1958.

U.S.S.R.—The Soviet Union reports that it has "overfulfilled" its industrial production goal for the first six months of 1959. Output increases include: pig iron 1,715,000 metric tons; steel 2,345,000 tons; rolled steel 1,670,000 tons. In the first half of the year actual production for these items is reported at: 21,000,000 metric tons of pig iron; 29,300,000 tons of steel, and 23,100,000 tons of rolled steel.

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AFRICA

UNION OF SOUTH AFRICA—A new mining company has been formed to take over development of 2,230 claims in the Waterpan Block about 18 miles south of the **Randfontein** mine on the Far West Rand. The company is called **Western Areas Gold Mining Company** and will be administered by the **Johannesburg Consolidated Investment Company.** Two shafts are to be sunk, starting next year. It is hoped that gold production can start in 3½ years at a milling rate of 50,000

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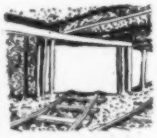

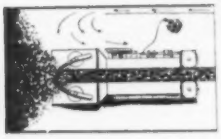

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tons a month. This will eventually be expanded to 200,000 tons a month. Initial ore output will be treated at the Randfontein plant. The possibility of building a separate plant will be considered from time to time. This is expected to be a medium-grade mine with average gold values of 5.5 to 6.0 dwts per ton. Ore reserves are estimated at 68,000,000 tons.

NIGERIA—Further details on the merger of **United Tin Areas of Nigeria** and **Ribon Valley (Nigeria) Tinfields** have been announced. Ribon Valley would be placed in liquidation so that United Tin could acquire the assets. The plan is designed to cut costs by concentrating mining operations in the most economic area; full use is to be made of the improvement in the market for columbite by resuming operations on the **Odegi** leases. Both companies are also engaged in prospecting for gold in northern Nigeria. A jet suction dredge is to be used if this method of operation proves successful.

BELGIAN CONGO—A record output of 260,000 tons of copper is expected this year by **Union Miniere du Haut-Katanga.** Last year's output was 235,586 tons of copper-bearing ore.

FEDERATION OF RHODESIA & NYASALAND—**Rhokana Corporation,** the only uranium producer in Northern Rhodesia, closed its uranium plant on July 31, after a little more than two years of operation. The plant had been erected in May 1957 to treat the small uranium-bearing deposit in the Mindola ore body. Most of the available ore has now been mined. Total production to the end of June was 220,000 pounds of uranium oxide. Though production costs were high, total expenditure on the plant was recovered.

SOUTHERN AFRICA—An **Economic Survey Mission** has been appointed to conduct a general survey of the requirements and natural resources of the Basutoland, Swaziland, and Bechuanaland Protectorates. It will make recommendations on the application of financial resources that exist or might be made available for development. The Mission has been appointed in consultation with the **International Bank of Reconstruction and Development.** Chairman is Professor C. Morse of Cornell University in the United States. Other members are Sir G. Hadow, Brigadier C. G. Hawes, N. Lees, and Professor J. F. C. Phillips.

UNION OF SOUTH AFRICA—**Loraine Gold Mines Ltd.** expects to complete sinking of its No. 3 shaft (formerly the Riebeeck No. 1) by December, with production from the area expected by early 1961. Under terms of the agreement between **Riebeeck Gold Mining Company** (now taken over by Loraine) and **General Exploration Orange Free State Ltd.,** at least 40,000 feet of development on the Upper Reefs from this shaft, excluding

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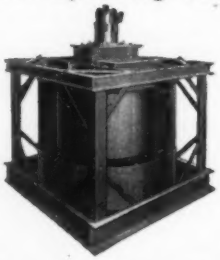

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stations, crosscuts, and other development mentioned in the agreement, must be accomplished before it is determined whether a satisfactory mine exists in these Upper Reef horizons. Should a satisfactory mine be established, the rights to deal with the Lower Reefs would then be transferred to General Exploration Orange Free State Ltd. and its participants.

SWAZILAND—Promising chrysotile asbestos deposits have been exposed in pits and by drilling in the Mbabane district, but further work is necessary for more accurate description and assessment. Further exploratory work is also being undertaken by **Johannesburg Consolidated Investment Company Ltd.** on the cinnabar occurrence in the Pigg's Peak District. The same firm is also prospecting a fluorspar deposit in the Hlatikulu district. Greater interest is indicated in the gold deposits, and the **Geological Survey and Mines Department** obviously feels that further interest is fully justified, despite the refractory nature of much of the ore. The **Swaziland Iron Ore Development Company,** with which **Anglo American Corporation** is a major associate, continues its active exploration on iron ore deposits in the Mbabane district, and plans to apply for a prospecting permit over adjacent siderite deposits. Mapping will be followed by drilling. Perlite occurrences are also being investigated in the Hlatikulu district.

UNION OF SOUTH AFRICA—A chrome ore processing plant in Rustenburg will supply all of the chrome ore demands of **Bayer A. G.,** chemical manufacturer in West Germany, and its Latin American subsidiary. Operated by **Bayfiiorin Rustenburg Chrome Mines, Ltd.,** the plant will process the ore and ship it via Lourenco Marques in Mozambique to West Germany or to Rio de Janeiro, Brazil plant of **Belford Roxo del Bayer Do Brasil Industrias Quimicas, S.A.**

MOROCCO—**L'Omnium Nord-Africain** has named its new director-general, Monsieur Nesterenko. The firm controls several mining companies in Morocco, namely: **Compagnie de Tifnout-Tiranimine,** which is developing a manganese deposit south of Marrkesh; **Societe Miniere de Bou-Azzer et du Graara,** developing a cobalt mine south of Ouarzazate; **Societe Miniere de Ksiba,** which owns a lead mine in central Morocco; **Societe des Mines des Bou-Skour,** developing a copper mine south of Ouarazazate. **L'Omnium Nord-African** also controls the **Societe de Transports Miniers,** which transports manganese ore over the Great Atlas Mountains by truck and aerial tram to the rail-head at Marrkesh.

NIGERIA—The **Bisichi Tin Company (Nigeria) Ltd.** is examining other properties in order to improve its mining position. Its principal income had come from columbite sold to the United States government for stockpiling with a 100 percent bonus price, but this program has been completed. The company's columbite is still greatly in demand because of its freedom from impurities and its high columbite-tantalum ratio, and efforts are being made to find adequate outlets.

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49 FD 8984	Water Wagon	Indianapolis, Indiana
49 FD 7761	15 tons	Lancaster, Pennsylvania
49 FD 8179	15 tons	Lancaster, Pennsylvania
49 FD 10178	15 tons	Lancaster, Pennsylvania
49 FD 10179	15 tons	Lancaster, Pennsylvania
49 FD 10180	15 tons	Lancaster, Pennsylvania
46 TD 13403	22½ tons	Lancaster, Pennsylvania
46 TD 13418	22½ tons	Lancaster, Pennsylvania
8 TD 7218	22½ tons	Indianapolis, Indiana
8 TD 6589	22½ tons	Indianapolis, Indiana
46 TD 13417	22½ tons	Globe, Arizona
46 TD 13395	22½ tons	Globe, Arizona
46 TD 13396	22½ tons	Globe, Arizona
49 FD 6753	15 tons	Indianapolis, Indiana
49 FD 7471	15 tons	Indianapolis, Indiana
63 TDA 21201	22½ tons	Ogden, Utah
63 TDA 21205	22½ tons	Ogden, Utah
63 TDA 21709	22½ tons	Ogden, Utah
63 TDA 21203	22½ tons	Ogden, Utah
63 TDA 21206	22½ tons	Ogden, Utah
63 TDA 21216	22½ tons	Ogden, Utah
63 TDA 21204	22½ tons	Ogden, Utah
63 TDA 21708	22½ tons	Ogden, Utah
49 FD 10108	15 tons	Indianapolis, Indiana
49 FD 10177	15 tons	Indianapolis, Indiana
49 FD 7245	15 tons	Indianapolis, Indiana
49 FD 7239	15 tons	Indianapolis, Indiana

BUCYRUS ERIE 6½-8 YARD SHOVELS FOR SALE

Model	Serial No.	Location	Year
150 B	116029	Ogden, Utah	1957
150 B	116819	Ogden, Utah	1957
150 B	116027	Ogden, Utah	1957
150 B	116028	Ogden, Utah	1957
150 B	116020	Ogden, Utah	1957

1—Northwest 80D Combination Shovel, Dragline & Crane—Serial 18501—Location Ogden, Utah
1957 Machine
4—WD60 Koehring Dumpters
2—Used 36TD Boxes
3—Used FD Boxes
Sacramento, California

Mesaba Service & Supply Company
Hiway 169 East & Thirteenth Street
P.O. Box 121, Hibbing, Minnesota
Telephone AMherst 3-6831

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–WOOD PIPE and WOOD TANKS–

Ore Bins
Tailings Pipe

6851 E. Marginal Way
Seattle 8, Wash.

CLASSIFIED ADVERTISING

FOR SALE: 1 Loader, Joy Hard-Rock, class 18 HR-2, with 440 Volt open-type motors and 27⅛ rear conveyor, 12 TPM, good operating condition. Inspection invited; will demonstrate; prices advised on request. Geo. W. Kerford Quarry Co., P. O. Box 468, Atchison, Kansas (telephone: 1206)

MEXICAN MINING CLAIMS, duly titled and located near the colonial city of Taxco, Mexico, and silver are offered to the serious American investors. Also we have mercury mines in the same region. For further details, write: Raymundo Alvarez Llaneza, Leon de Los Aldamas, 67, Mexico 7, D. F.

MINE OPERATOR NEEDS financing on mine containing Gold, Silver and Lead near Elko, Nevada. Operator has $40,000 of mining equipment. Write J. R. Davies, Box 1185, Elko, Nevada.

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CLASSIFIED ADVERTISING

MINE SUPERINTENDENT AND METALLURGIST REQUIRED

For mineral sand mining operation to be located in New Jersey. Excellent opportunities offered for men with right qualifications.

QUALIFICATIONS FOR MINE SUPERINTENDENT:

Age 30-45. Graduate of university or school of mines. At least eight years experience in open pit dragline operations where rigid control of mining path and depth was necessary. The last five years to have been in a senior supervisory capacity. Should be experienced in the use of heavy equipment pump preparation and planning.

QUALIFICATIONS FOR METALLURGIST:

Age 30-45. Graduate of university or school of mines with degree in metallurgy. Must be experienced in the concentration and separation of sand ilmenite ores using spirals and other wet gravity methods. Also high tension and magnetic separation of ilmenite and related minerals. Should be qualified to take over duties of mill superintendent when plant is in operation.

Applications from completely qualified men alone will be considered. Reply with complete details and salary desired to:

Manager, Mining Division
The Glidden Company
RD. #4, Box 150
Lakewood, New Jersey

NEW MINERAL DISCOVERY IN ARKANSAS of approximately 4000 acres of the following minerals: vast deposits of 43% manganese; copper 2% and better; barite showing for about 7 miles in faults, "evaculite" wall rock. High grade ore over 10% iron silicon, 5%-10% aluminum, 2% chromium manganese-sodium, 1% boron lead, less than 1% calcium titanium mangesium, less than 1% zinc, nickel, silver, tin. This mineral is all in lode. Abstracts if desired. Assays from shallow depths for lease. Cogburn and Lance Mining Co., Olita, Oklahoma.

PRODUCT ENGINEER MINING EQUIPMENT

East Coast Manufacturer seeks engineer for Sales Department. Will coordinate equipment inquiries and sales activities with Engineering and other departments, assist in preparation of sales reports and prepare estimates and proposals for mining equipment. Prefer Mining Engineer with 1-3 years experience in application of materials handling equipment for mining industry. Submit resume and salary desired to Box P-3, Mining World, 500 Howard Street, San Francisco 5, Calif.

GEOLOGIST: Twenty years experience mining exploration, prospecting and development—some mine geology—go anywhere—some Spanish. Available November 1st. Write Box P-2, Mining World, 500 Howard Street, San Francisco 5, Calif.

Wanted ENGINEER-SUPERINTENDENT for 60 TPD lead, zinc, silver mining and milling operation, Central America, selective flotation. Good opportunity for energetic man experienced in both vein mining and milling; must speak and read Spanish, two-year contract, $550.00 per month plus travel allowance, furnished house with utilities, healthful climate 500 ft. elevation. Reply giving experience, qualifications, education, marital status, children and ages, recent foto. Reply to Box Q-2, Mining World, 500 Howard Street, San Francisco 5, Calif.

POSITION WANTED: Mine and mill master mechanic. 16 years experience in medium sized open pit, underground operation. Experienced mill and gravel plant construction. Sober, reliable. Write Mining World Box Q-1, 500 Howard St., San Francisco 5, Calif.

MASTER MECHANIC

(British Guiana)

U. S. aluminum producer has opportunity for competent man to supervise electrical and mechanical maintenance. Must be familiar maintenance and repair open pit mining equipment, Diesel electric generators, electrical distribution systems, etc. Previous overseas mining experience helpful but not essential. Prefer married man with no family. In letter give complete details on age, education and experience, including types of equipment handled. Write Mining World Box O-2, 500 Howard Street, San Francisco 5, Calif.

MINING ENGINEER - MANAGER seventeen years experience in operations, exploration, management in U. S. and six foreign countries. Speaks Spanish. Will work foreign. Will furnish detailed resume. Reply Box 786, Aspen, Colorado.

BEFORE You Buy a THICKENER...BE SURE!

USE DENVER Testing Service

TO DETERMINE CORRECT THICKENER SIZE FOR YOUR NEEDS.

No cost to you for this test service!

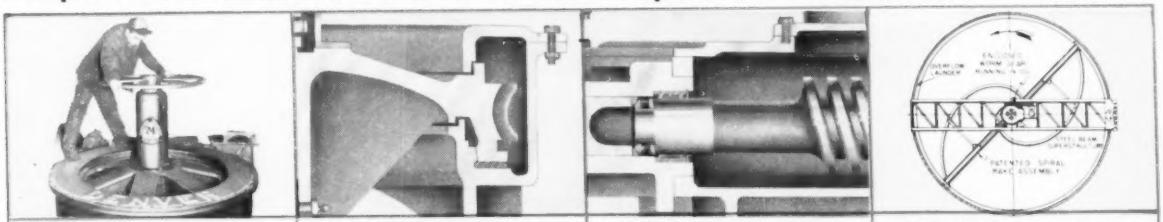
ELIMINATE RISK!

Let DENVER's 30 years of laboratory and world-wide field experience help you to eliminate risk—determine the right thickener for your needs—verify your own tests or recommendations of others. DENVER's experience covers a wide variety of materials plus the opportunity to relate test results to actual field operations. Laboratory tests, conducted at no cost to you, supply reliable data on

- **(A) Settling Rates**
- **(B) Final Density**
- **(C) Effect of Flocculating Agents**
- **(D) Thickener Unit Area**
- **(E) Overflow Clarity**

TESTS AT NO CHARGE—*These tests can assist you by eliminating risk of specifying a thickener that's too small to do the job or too large and costly for your needs.* Ship 5 gallon slurry sample prepaid to Denver Testing Division, 1755 Blake St., Denver, Colo.

Compare these distinctive features of DENVER Spiral Rake Thickeners:



NEW ENCLOSED HOUSING protecting gear and drive mechanism is simple and rugged—available in sizes through 72" for light, medium, heavy and extra heavy duty. Tanks, steel or wood, in sizes to 150'. Write for Bulletin T5-B6.

HIGH STRENGTH GEAR rides on replaceable no friction—no wear formica pads placed at periphery of the gear. Maximum stability, low bearing pressure and oil bath assure long life.

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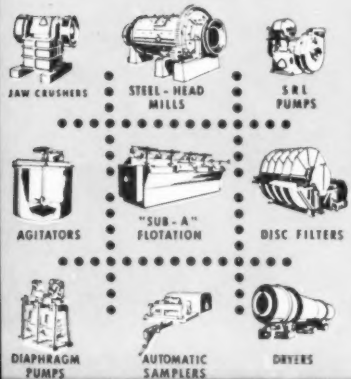
SPIRAL RAKES move settled solids to center discharge port in only one revolution. Minimizes chance of choke-up, assures continuous operation. Why take 8 or 10 revolutions to bring pulp to the discharge cone when one revolution by the spiral rakes will do?



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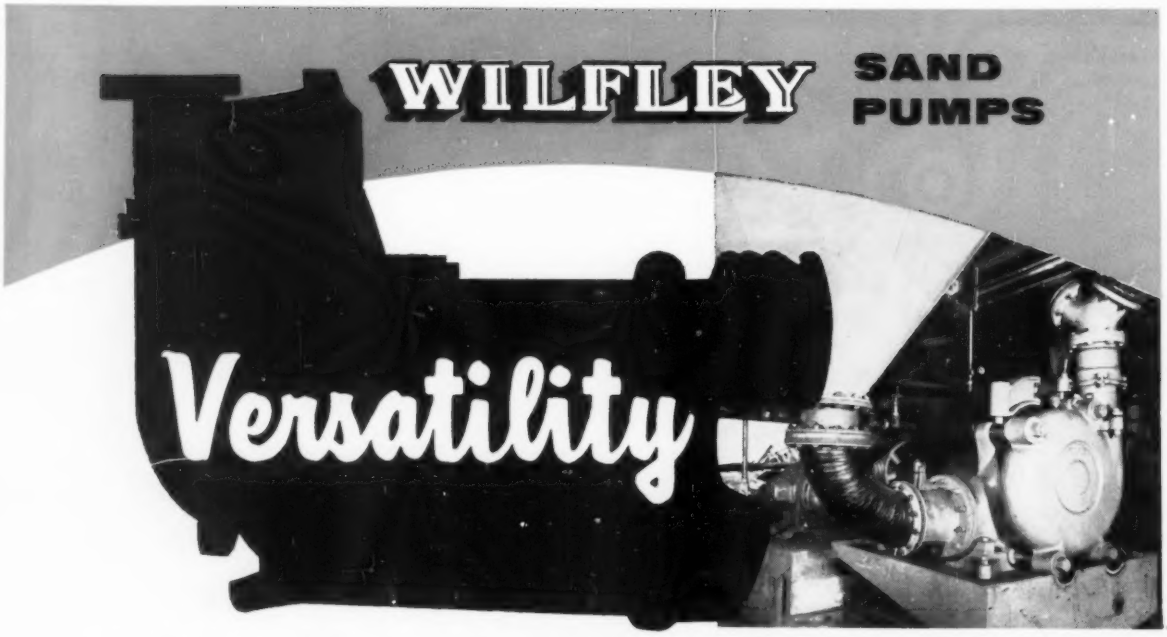
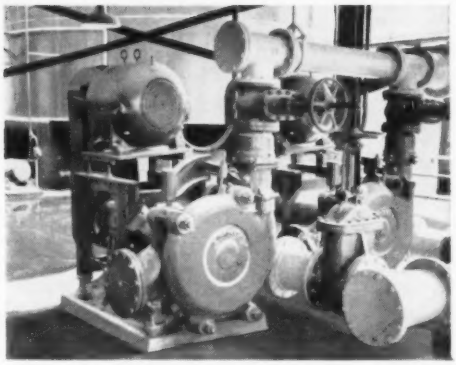
WILFLEY SAND PUMPS



to Solve Your SPECIFIC Pumping Problems



Every year the applications for Wilfley Sand Pumps become more varied. So **many** industries now require low cost pumping of sand, slimes, slurries—abrasive solutions of all types. Wilfley Sand Pumps are designed to meet all requirements in the transfer of solids. They may be fitted with interchangeable electric furnace alloy iron, special application alloys, or rubber-covered wear parts. Whether you need belt driven, overhead V-belt driven, or direct driven pumps, Wilfley has them—available in **1", 1½", 2", 2½", 3", 4", 5", 6", 8"** and **10"** discharge sizes with capacities to 3600 GPM and heads as high as 200'.

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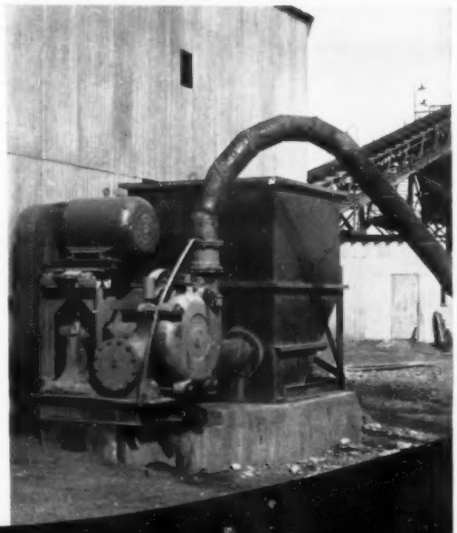

Write, wire or phone for complete details.

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